# NATURE

Vol. 143 SATURDAY, MARCH 18, 1939 No. 3620

## CONTENTS

| | PAGE |
|---|---|
| Organization and Development of Museums | 447 |
| The Scientific Work of Charles Fabry. By F. Twyman, F.R.S. | 449 |
| Explorations in Climatology. By C. E. P. B. | 451 |
| Egyptian Prehistory. By K. B. | 452 |
| The Ways of the Red Deer | 453 |
| A Living Fish of Mesozoic Type. By Dr. J. L. B. Smith | 455 |
| A Tentative Land Fertility Map of England and Wales. By Dr. L. Dudley Stamp | 456 |
| National Nutrition Policies. By Sir John Boyd Orr, F.R.S. | 459 |
| Element 43. By Prof. E. Segrè | 460 |
| Obituary Notices: | |
| Prof. Henry Louis. By Prof. J. A. S. Ritson, O.B.E. | 461 |
| Dr. W. E. Grimshaw, O.B.E. By C. A. C. | 462 |
| Dr. G. H. Carpenter. By A. D. I. | 462 |
| Dean L. P. Reinhold Matsson. By Dr. C. C. Hurst | 463 |
| Mr. C. H. Jenkinson. By W. H. B. | 463 |
| News and Views | 464 |
| Letters to the Editor: | |
| Liberation of Neutrons in the Nuclear Explosion of Uranium.—Dr. H. von Halban, jun., Prof. F. Joliot and Dr. L. Kowarski | 470 |
| Products of the Fission of the Uranium Nucleus.—Prof. Lise Meitner and Dr. O. R. Frisch | 471 |
| Radioactive Organic Bromo-Compounds.—Prof. E. Friedmann, A. K. Solomon and N. T. Werthessen | 472 |
| Catalytic Exchange of Deuterium and Hydrogen in Hydrocarbons.—S. R. Craxford, G. H. Twigg and Prof. Eric K. Rideal, M.B.E., F.R.S. | 472 |
| Chemical Aspects of the Cyclol Hypothesis.—Dr. A. Neuberger | 473 |
| Chromatographic Fractionation of Whale-Liver Oil.—Harry Willstaedt and Dr. Hans Behrnts Jensen. | 474 |
| Formation of Negative Ions by Negative-Ion Bombardment of Surfaces: a New Process.—R. H. Sloane and Miss Eliza B. Cathcart | 474 |
| Oxidation of Reduced Codehydrogenase I.—V. R. Potter | 475 |
| Time-to-Time Variation in the Response of Ovariectomized Mice to Œstrone.—C. W. Emmens | 476 |
| The 'Fossula Spongiosa' in Reduviidæ.—N. C. E. Miller | 477 |
| Increasing Winter Egg-Production in Spain more than a Hundred Years Ago.—Dr. John R. Baker | 477 |
| Terminology in Biology.—Dr. B. Barnes and C. C. Hentschel | 478 |
| Research Items | 479 |
| The Structure of the Globular Proteins. By Dr. Dorothy Wrinch | 482 |
| 'Stump' Planting | 484 |
| Intelligence and Birth-Rate. By J. I. Cohen | 484 |
| Protection of the Fauna and Flora of Africa. By Dr. Percy R. Lowe, O.B.E. | 485 |
| The Morphology of the Carpel | 486 |
| The S.S. *Archimedes* | 487 |
| University Events | 487 |
| Societies and Academies | 488 |

Editorial and Publishing Offices:
MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London
The annual subscription rates are: £2 12 0 British Isles, £2 17 0 Foreign, payable in advance

Advertisements should be addressed to
T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4. Telephone Number: City 4211
Registered as a Newspaper at the General Post Office
All rights reserved

**THE PRINCIPLES OF ELECTROCHEMISTRY**

By DUNCAN A. MacINNES, Associate Member The Rockefeller Institute for Medical Research
*Medium 8vo.* *478 pages, 148 figures.* 30s. *net.*

**THE SCIENCE OF ANIMAL LIFE**

By ARTHUR WARD LINDSEY, Professor of Zoology, Denison University
*Medium 8vo.* *667 pages. 304 illustrations and figures.* 15s. *net.*

**ELECTRON OPTICS: Theoretical and Practical**

By L. M. MYERS, Research Department, Marconi's Wireless Telegraph Co., Ltd.
*Medium 8vo.* *636 pages, 380 illustrations and figures.* 42s. *net.*

**THE LIVING BODY. A Text in Human Physiology**

By CHARLES HERBERT BEST, M.A., M.D., D.Sc.(Lond.), F.R.S., F.R.C.P.(Canada), and NORMAN BURKE TAYLOR, M.D., F.R.S.(Canada), F.R.C.S.(Edin.), F.R.C.P.(Canada), M.R.C.S.(Eng.), L.R.C.P.(Lond.). Both of the University of Toronto
*Demy 8vo.* *585 pages, 15 colour plates and 283 illustrations.* 18s. *net.*

**HANDBOOK OF FOOD MANUFACTURE**

By F. FIENE and SAMUEL BLUMENTHAL
*Medium 8vo.* *609 pages.* 25s. *net.*

**PHOTOGRAPHIC CHEMICALS AND SOLUTIONS**

By J. I. CRABTREE and G. E. MATTHEWS, both of the Kodak Research Laboratories
*Medium 8vo.* *367 pages, 95 figures.* 21s. *net.*

**THE BASIC MECHANICS OF HUMAN VISION**

By R. BROOKS SIMPKINS
*Demy 8vo.* *236 pages, 8 plates and 79 figures.* 12s. 6d. *net*

CHAPMAN & HALL, LTD., 11 HENRIETTA STREET, LONDON, W.C.2

Bausch & Lomb

**GGBET**

**Research Microscope**

Confidence in an instrument increases efficiency.

The **full guarantee** given with all **B.&L.** microscopes gives you this confidence.

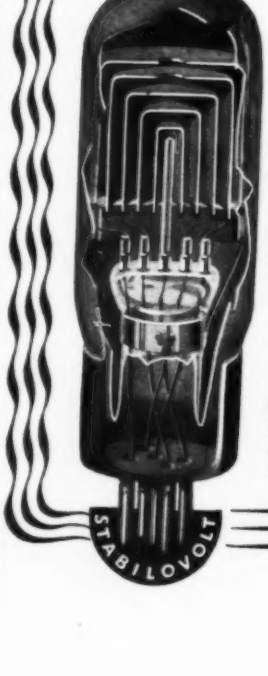
They are optically and mechanically dependable.

●

*Catalogue on request*

**Bausch & Lomb Optical Co. Ltd.**
Africa House
KINGSWAY LONDON, W.C.2

**STABLE VOLTAGE**




**—the only solution to the problem of unstable supply voltage is the**

**STABILOVOLT**

**CURRENTS UP TO 200 mA**

Write for new pamphlet giving reduced prices and additional ranges. Full particulars from

**MARCONI'S**
WIRELESS TELEGRAPH CO. LTD.
Electra House, Temple Place, London, W.C.2.

Editorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 143 SATURDAY, MARCH 18, 1939 No. 3620

# Organization and Development of Museums

IT is keeping within the truth to say that in Great Britain and Ireland a new museum is born every three weeks, roughly twenty in a year, or two hundred since Sir Henry Miers's report to the Carnegie United Kingdom Trustees was published in 1928. That is an index to the enthusiasm of groups of people aware that there are hidden things the public ought to see ; but, alas, it is no index to the foresight of the enthusiasts, for the history of museums indicates that many of the new foundations, without endowments or any guarantee of permanent backing, will sooner or later drop out of the running and disappear. The death-rate of museums all but keeps up with the birth-rate ; but the spectacle of the lingering death of the idea embodied in a collection which has outlived its interest does infinite harm to the museum movement.

Museums die because the people do not want them, at any rate in the form which their presentation too often takes ; and if only the secret of a live interest could be discovered, and the discovery were rigidly and universally applied, a new page would be opened in the museum story. A great contribution towards this end is made in S. F. Markham's recent report to the Carnegie United Kingdom Trustees*, a book which ought to be pondered over by everyone interested in the present condition and potential future of the museums and art galleries of Great Britain.

The origin of the report is of historic interest. Ten years ago, Sir Henry Miers wrote the first thorough-going account of the museums of Great Britain, also for the Carnegie United Kingdom Trustees, and having exhibited the pitiful shortcomings of the museum service, which in his opinion required complete reformation, he made suggestions for improvement along three lines—by individual effort on the part of museum authorities, by co-operation, and by the helping hand (or purse) of external bodies. Anyone who takes the slightest interest in these public institutions must be aware of the stimulus Sir Henry Miers's investigation gave to the museum movement and the progress in certain directions made during the decade which has elapsed.

Mr. Markham acted as secretary to Sir Henry Miers ; he has since carried out a survey of museums in most of the British Dominions and Colonies and in India, on behalf of the Carnegie Corporation of New York ; so that no one could have been better equipped for the new British survey which the trustees desired to make, in order to assess the progress of the past ten years and to foreshadow the needs of the future.

Many years ago (1889), Sir William Henry Flower, in his presidential address at Newcastle-on-Tyne to the British Association for the Advancement of Science, defined the purposes of a museum as the advance or increase of knowledge in some given subject, and the diffusion of knowledge among the interested public—in short, the two aims of research and instruction. Half a century has seen great developments in museum standards, but the aims remain essentially the same. The first great purpose is to collect and conserve objects of historic, scientific or artistic importance for our own and future generations ; there follows the furthering of specialized knowledge by research in these collections, the more recent and very

* A Report on the Museums and Art Galleries of the British Isles (other than the National Museums), by S. F. Markham. Pp. iii + 179 + 24 plates. (Dunfermline : Carnegie United Kingdom Trust, 1938).

insistent aim of the education of the people by attractive exhibits, and the ultimate ideal of stimulating love of beauty or endeavour in some branch of human achievement.

Every museum cannot compass all these objects, but every museum must set out with its objective clearly conceived and must bend its activities to the accomplishment of its particular goal. But the goal is never attained. The essence of museum success—even of museum existence—is perpetual striving and continuous progress. The only type of museum which can afford to remain static is that devoted to perpetuating the memory of a great personage—Shakespeare, Livingstone, Wolfe, to mention recent examples—where personal relics are bound to be limited in number, and where the attraction is predominantly emotional rather than educational. These, however, form a relatively small proportion of Great Britain's museums: of our eight hundred museums, "about 165 are devoted to a historical or personal theme, 100 to natural history alone, about 80 to art, 20 to medicine, and 20 to industry. The remainder, therefore, totalling some 400 museums, are general in their character, though many, probably 150, have a distinct emphasis upon illustrating their immediate environment" (p. 52).

Sir William Flower wisely said, in the address referred to, "A museum is like a living organism—it requires continual and tender care. It must grow, or it will perish." We would prefer to say 'develop' rather than 'grow', for there is an impression that the addition of new rooms always means progress, whereas extensions may actually hinder the development constantly required in any collection. But the plain fact is that museums die (and we know of collections excellent in their day, and their day opened nearly a century ago, disappear in recent years) because they have become moribund—activity, the breath of life, has departed from them long ago.

The first essential for a developing museum (and all others are moribund) is a competent curator, who has the knowledge, the skill and the brains to plan and execute; and a competent curator deserves his reward—he may at least expect a living wage. Yet, apart from a hundred and forty out of more than eight hundred museums in Great Britain, "in nearly every other case the curator is paid a scandalously low salary". There are pitiful examples mentioned by Mr. Markham of *salaries* of £50 recently raised to £75 or to £100 a year. The County Borough of West Ham (population 294,000) offered £155 per annum for "a full time assistant with biological training, knowledge of photography, and a Science degree (not essential)"; the County Borough of Reading (population 100,000) advertised for "a male assistant with practical Museum and Art Gallery experience, not under 22 and preferably registered for the Diploma, salary offered £115". And the London County Council pays its dust-collecting gangers £158 and its dustmen £150 a year! Is it surprising that dust accumulates and men and ideas decay in some of the provincial museums?

The ten years which have passed since Sir Henry Miers made his recommendations have emphasized the backwardness of the weaker museums (nearly four hundred and fifty in number), since the better institutions have taken advantage of new opportunities and have pushed ahead. There is closer co-operation between them, expressed in flourishing regional federations, and in the growing power of the Museums Association; they have been aided and advised to a greater extent by the national museums; and they have made more use of the development of exhibition technique, to the great benefit and the educational value of their halls and galleries.

The increasing museum contribution to education in progressive institutions has indeed been one of the impressive features of this century. Not only have greater efforts been made to replace dull collections by displays in which art and science blend for the attraction and instruction of the public, but a deliberate attack upon indifference has also begun. Temporary exhibits of objects of particular interest, special exhibitions illustrating achievements of, or developments in, art and science, the increasing use of modern methods of publicity, in which the newspapers have proved loyal helpers, the encouragement of regular school visits, and the circulation of loan collections among schools—all these devices have become part of the recognized services of museums to the public; and the public has responded by showing a new and increasing interest in museums.

But something still is lacking. Efforts tend to be spasmodic and confined to comparatively few centres; improvements are costly, and municipalities and private bodies are already hard put to it to find the funds required, even if they were sure of the most desirable lines of advance; and there are museums that are static, because no interest is taken in them. If the country's museums over all are to be made worthy of the

great purposes which it is in their power to serve, some beneficent *deus ex machina* must appear to weld the scattered units into a national movement. Whether that kindly guiding power shall be vested in a Government department, or shall emerge from the museums themselves by way of the Museums Association, it is essential that it should have two basic functions: first, that of giving advice where advice is sought, and of making recommendations where museums are moribund, and secondly, that of subsidizing improvements and encouraging developments by the use of moneys allocated by Government for museum purposes.

So, as Mr. Markham says: "In the mind's eye one can see organised throughout the length and breadth of the country temples of vision, where young enthusiasts will find a ready welcome and a helping hand with a colossal book of knowledge; schools will have auxiliaries on the cultural side not less than those which playing-fields now give them on the physical side, and adults will find in these centres a combination of relaxation, interest, and ever-widening horizons."

---

# The Scientific Work of Charles Fabry

**Œuvres Choisies**

Par Charles Fabry. Publiées à l'occasion de son jubilé scientifique. Pp. vi+695. Jubilé scientifique de M. Charles Fabry célébré à la Sorbonne le 3 décembre 1937. Pp. 96. (Paris: Gauthier-Villars, 1938.)

WHEN, in 1937, Charles Fabry retired from his professorship in the University of Paris, he was persuaded to arrange and edit his principal scientific papers. The "Œuvres Choisies" is the result.

It is an impressive record, not so much from the actual amount of reading matter, though that is considerable, but because the author by selection and compression has been able to present an adequate record of the main results of half a century's research in about two hundred and fifty thousand words.

Before we attempt to summarize the contents of the book, let it be said at once that Fabry's love of research was accompanied by a devotion to teaching. He has said himself: "Toute mon existence a été consacrée à la Science et à l'enseignement, et ces deux grandes passions m'ont procuré les plus vives joies." There are, perhaps, not many teachers who could refer to their vocation with such enthusiasm; but all would agree that it is a great consumer of time and energy. In assessing the magnitude of Fabry's work one must read between the lines of his paper a story of tireless activity as an inspiring and greatly loved teacher.

To return to Fabry's "Œuvres Choisies". He was only about twenty years old when he took a post at the Faculté des Sciences at Marseilles under Macé de Lépinay. It was not long before the two published in collaboration a paper on the "Theorie générale de la visibilité des franges d'interférence" (1891). Thus early the keynote was struck which was to echo through so much of Fabry's work—more than half the book is concerned with the phenomenon of the interference of light and its application to the solution of physical problems.

About five years later, Fabry commenced to study the interference fringes of silvered plates in collaboration with A. Perot, and in 1897 they published the first important description of the Fabry-Perot type of interference fringes and their use in the measurement of length.

This was the type which Fabry always used thereafter, its advantage lying in the much greater fineness of the fringes as compared with those used, for example, by Michelson.

In a series of papers, Fabry and Perot described the properties of these fringes; how to determine the number of the order of a fringe corresponding to a large path difference, how to use them for the measurement of lengths up to several decimetres, and for the comparison of wave-lengths of different rays (1898 and 1899). They then applied the method to determine the size of a 4 cm. cube of quartz in wave-lengths of cadmium red light, and with Macé de Lépinay determined by its aid the mass of a decimetre of water. Other papers on interference metrology finally led, in 1907, to the epoch-making "Nouvelle détermination du mètre en longueurs d'ondes lumineuses" and the "Détermination de la longueux d'onde de la raie rouge du Cadmium".

This determination led to Benoît, Fabry and Perot making, in 1907, at the Conference of the International Union for Co-operation in Solar Research at Meudon, the following recommendation: "La longueur d'onde de la raie rouge de la lumière

du Cadmium produite par un tube à électrodes est 6438,4696 Angström, dans l'air sec 15° du thermomètre à hydrogéne à la pression de 760 mm. de mercure, la valeur de g. ètant 980,67 (45°). Ce nombre sert de definition a l'unité de longueur d'onde."

This recommendation was adopted by the Conference. Twenty years later (1927) the determination was officially recognized by the Comité (and later by the Conférence générale) du Bureau International des Poids et Mesures as still the best. In June 1936, Fabry was able to show at a session of the same Committee that, applying certain new corrections discovered at the Reichsanstalt, the measurements were in excellent accord with the latest made at Teddington and at Berlin.

Fabry and Perot then turned their attention to the use of their étalon for determining wave-lengths. Previously the wave-lengths of rays had been found by comparing their positions in a spectrum with those of other rays the wave-lengths of which had been determined by Rowland from the measured dimensions of a grating. Fabry and Perot set themselves to determine a number of wave-lengths by comparison with one selected ray, with all the accuracy attainable with their new method.

The technique for carrying out this work was published during the years 1898–1900, a further application being added, that, namely, of determining in a like manner the wave-lengths of the Fraunhofer lines of the solar spectrum. In 1902 they published thirty-three wave-lengths of the solar spectrum determined in this way, together with the wave-lengths of a number of metals, including iron; altogether more than sixty wave-lengths being given to the seventh decimal place.

In a subsequent paper (1905), they described their more expeditious way of determining intermediate wave-lengths by forming an image of the diffraction pattern yielded by one of their étalons on the slit of a spectrograph.

To apply the method to measurements of extremely small variations of wave-lengths was but a short step, and Fabry and Buisson in 1910 studied in this way such problems as the widths of the line of the solar spectrum, the Doppler-Fizeau effect on rays from the circumference and middle of the solar disk, the kinetic theory of gases, and the internal movements of the Orion Nebula. Differences of line of sight velocities present in the nebula were determined to a much greater accuracy than had before been possible.

To study the Doppler-Fizeau effect in the laboratory, Fabry devised a very ingenious piece of apparatus, using a revolving disk of white paper as the means of producing a moving source of light.

There is no space to deal here with minor applications of interferometry, such as the determination of the voltage of a Latimer-Clark standard cell in absolute electro-static units.

The next section of Fabry's work became of great practical interest in the highly technical problem of heterochromatic colorimetry. This presented difficulties which increased with every new source of illumination.

Fabry put forward the suggestion in 1903 that the problem should be simplified by the use of liquid colour filters which, placed between the standard lamp and the photometer, gave a colour match with the lamp to be measured. The transmission of the filters could be carefully determined once for all to the necessary accuracy, and then all subsequent measurements could be made under conditions involving no colour difference. When he put forward this suggestion at the Academy of Sciences in November 1903, it met with great opposition—indeed, the member who presented the note for Fabry wrote to him that he did so only "après beaucoup d'hésitation". Nevertheless, in a few years the method was accepted throughout the world, as were also the views on the universal unit of illumination, put forward by Fabry in his report on the subject to the International Commission on Illumination in 1921.

Lack of space forbids more than a mention of Fabry's work in astrophysics in connexion with photometry of the sun, stars and night sky, and the diffusion of light by gases; but something more must be said concerning his study of the ultra-violet end of the solar spectrum. In a preliminary investigation he came to the conclusion that the limit to the ultra-violet spectrum of the sun results from three causes: molecular diffusion, scatter by dust or other fine particles, and absorption by ozone; and he then proceeded to work out a technique whereby the amount of ozone could be measured.

Such measurements are now regularly made in the manner developed by Fabry. The theory had long before been put forward by Hartley that the limits of the solar spectrum were due to ozone, but no measurements had been made previously to Fabry's in support of this hypothesis.

In 1937, Prof. Charles Fabry was seventy years of age, and on the occasion of his jubilee celebration he told his audience that he was accustomed to using logarithmic tables at the age of eleven years, and could almost say that he learnt to read from the "Annuaire du Bureau des Longitudes". His undiminished ardour and vitality permit us to hope that he only closes this volume to commence a fresh one.

F. TWYMAN.

# Explorations in Climatology

(1) Handbuch der Klimatologie

Herausgegeben von W. Köppen und B. Geiger. Band 4, Teil T: Klimakunde der Südsee-Inseln, von Prof. Dr. G. Schott; und Band 4, Teil U: Klimakunde der Antarktis, von Prof. Dr. W. Meinardus. Pp. T114 + v + U133. (Berlin: Gebrüder Borntraeger, 1938.) 40 gold marks.

(2) Die Meteorologie des Sonnblicks

Teil 1: Beiträge zur Hochgebirgsmeteorologie nach Ergebnissen 50 jähriger Beobachtungen des Sonnblickobservatoriums, 3106 m. Von Ferdinand Steinhauser. (Herausgegeben vom Sonnblick-Verein.) Pp. 180 + 1 map. (Wien: Julius Springer, 1938.) 8 gold marks.

(1) THIS part of the great "Handbuch der Klimatologie" contains two sections, the South Sea Islands and the Antarctic. In spite of their apparent total dissimilarity, these two regions are alike in being represented by few and scattered climatological data, which are none the less impressive because they show the interaction of meteorological forces on a scale seen in few other parts of the earth.

The equatorial Pacific is the meeting-place of two great converging wind systems—the north-east and the south-east trades—which have swept over thousands of miles of tropical ocean and are hot and humid. By the canons of meteorology, convergence means forced ascent, and the meeting-place of the winds would therefore be expected, and was long supposed, to be a region of frequent and intense rainfall. Observations have shown, however, that the actual meeting-place of the winds is on the whole an arid region with a violently fluctuating rainfall which may sink almost to zero for months at a stretch. The expected heavy rains fall on either side of this dry strip, but especially to the southward, where the transition is very rapid. It is an interesting problem in the effects of air masses, to which the author recurs several times, though he does not bring out clearly the remarkable relation between wind direction and rainfall.

In the well-known trade winds themselves the rainfall on the small mountainous islands is almost entirely orographic. The steady winds and the rugged topography bring this out with almost startling emphasis, as, for example, in Oahu, Hawaii, where the annual rainfall varies from more than 236 inches on the peaks to less than 20 inches on the leeward shores. Incidentally, the rainfall charts for the Hawaiian islands are rather confusing because some are given in centimetres and one in millimetres.

The ice-covered Antarctic continent and the surrounding seas provide a great natural laboratory of a different type, where emphasis is laid on the effects of temperature. The author takes as the boundary of the sub-antarctic region not the shifting and uncertain limit of ice but the much more regular 'convergence line' where the cold antarctic waters meet the warmer seas of the main Southern Ocean. He thinks that it is the contrast of temperature across this boundary which provides most of the energy for the continuous storms of that region. The rest of the energy comes from outbreaks of cold air from the ice-covered continent, but these are confined to three separate regions. Elsewhere the outflowing winds are deflected by topography into great eddies the courses of which are reflected in the streams of drift ice. There is an interesting analysis of the conditions along the boundary between the antarctic and maritime winds, the more or less continuous antarctic polar front, but all this part of the earth is still rich in unsolved meteorological problems, both at the surface and in the upper air.

Both sections are well provided with diagrams, and all available statistical information is set out in the numerous tables which are a regular feature of the "Handbuch". In the Antarctic section perhaps a little too much is made of the scanty data by harmonic analysis, and one would have preferred more quotations of descriptive passages. There are very full bibliographies in both sections.

(2) The completion at the end of 1936 of an unbroken series of meteorological observations covering a period of fifty years, at a height of 10,190 ft. on the summit of the Sonnblick, marks a magnificent achievement, great not only for the scientific value of the results but also in terms of sustained effort against the difficulties of Nature, which can readily be appreciated from the coloured panorama slipped inside the front cover. This volume presents a summary of the climatological results with a wealth of detail.

The elements discussed include temperature, humidity, cloud and sunshine, precipitation, wind and pressure. The mean temperature for the year is only 20·5° F., falling to 8° F. in February, while only two months, July and August, have a mean just above the freezing point. Greater interest is attached to the secular variation. As is now well

known, the first fifteen or twenty years of the present century were mainly a period of mild winters and less definitely of cool summers in Europe. The same tendency is shown by the Sonnblick observations, proving that this change is not confined to the lowest layers of the atmosphere.

In humidity the mountain-tops present some unusual phenomena of the 'looking-glass' sort. Relative humidity is greatest in summer, and in summer it is greatest in the evening and least in the morning. This is because the whole layer of air below contracts during the night and expands during the day, while irregular movements cause some very rapid changes from one hour to the next. Cloudiness shows similar features, being greatest in summer, especially with easterly winds! Even the duration of sunshine is greater in March than in June but varies little throughout the year, while the percentage of possible sunshine is greatest in February and January. Sonnblick well supports the famous winter climate of the high Alps; Vienna presents a very different picture.

Mountain stations were formerly important as the only source of information about the winds at high levels and they are still valuable to control and supplement the pilot balloon observations. Sonnblick has a cup anemometer, and the results have already been the subject of some important memoirs. The present publication gives the results of the tabulations in great detail.

The discussions are supplemented by an impressive appendix containing full series of the monthly values of all elements, which will prove very valuable for reference. The whole work will appeal not only to meteorologists but also to all who know and love the Alps in their many moods.

C. E. P. B.

---

# Egyptian Prehistory

## Cemeteries of Armant I

By Sir Robert Mond and Oliver H. Myers. With Chapters by F. J. C. Baly, Dr. A. J. E. Cave, Suliman Huzayyin, Dr. J. W. Jackson, and Rev. De Lacy O'Leary, and other Contributions. The Text. Pp. xiii + 300. The Plates. Pp. xi + 78. (London: The Egypt Exploration Society, and Oxford University Press, 1937.) 25*s*.

IT is a far cry from digging treasures centuries ago to modern excavations, and between the first memoirs of excavations in Egypt and this book there is almost as great a difference. Its results are of interest not only to archæologists but also to students of natural science.

"Cemeteries of Armant I" is a report on the excavation of, for the most part, prehistoric cemeteries at Hermonthis (Armant) in Upper Egypt. There is also an account of a prehistoric settlement. In its production many experts have collaborated, with the result that it is not a mere survey of work done in the field but an attempt to apply new principles to the study of Egyptian archæology.

On one hand, the writers employ technological and chemical tests to a great—almost too great—extent in order to get the best out of "material of no outstanding value". They describe how beads were manufactured, and the different qualities of the brickwork which was used in tomb construction. They have analysed, by different methods, certain unique pieces of stuccoed linen found in a prehistoric tomb, perhaps a kind of primitive cartonnage similar to that which was used in later times for the covering of mummies. There are also metallurgical analyses and chapters on the anatomical study of human remains carried out *in situ*. Far-reaching theories concerning climatic changes in Africa are founded on the discovery of a new kind of pottery and traces of tree-remains in the desert sand. A valuable addition to archæological technique is the introduction of a colour-chart, based on the "Ostwald Colour Album", in order to facilitate the accurate description of the colours of beads and pottery.

Another characteristic feature of the book is the authors' emphasis on the need to improve the systems of classification hitherto current in Egyptian archæology, or to substitute new systems for the old. They suggest, for example, a new typology for pottery. Instead of arranging the pots in the first instance according to their pattern and shape—the system used by classical archæologists which Petrie introduced into the study of prehistoric pottery—they are to be classified primarily by 'ware', and only within that grouping by the orthodox method. The authors also criticize the two systems of classifying beads which are at present in use, but have not attempted to devise another because of the comparatively small

number of beads found in their own excavations. A long chapter is devoted to flint implements, of special importance since there is as yet no comprehensive account of the Egyptian flint industry. Only flints from Armant are treated here, but they are classified and illustrated in a way which it is hoped will provide a basis for all future work on flints. At the end of each chapter is a useful index of the objects discussed in it.

The whole book is distinguished by a thoroughness and a scholarship which does not shrink from confessing that the only iron ring found during the excavations—of which there is a photograph on one of the plates—was lost on the way to the laboratory! Nor are the authors afraid to state conclusions that are entirely negative.

This report of a single excavation is little short of a text-book alike for excavators and students of Egyptian prehistory, and should be studied by all who undertake research in the subject; even if, as is stated in the first chapter, "the parts are greater than the whole". K. B.

---

# The Ways of the Red Deer

## A Herd of Red Deer

A Study in Animal Behaviour. By Dr. F. Fraser Darling. Pp. x+215+8 plates. (London: Oxford University Press, 1937.) 15*s*. net.

OF the large land mammals which originally inhabited the British Isles, civilization has left as sole survivors the deer, and of these the red deer, saved from extinction because of their value throughout the ages for the chase, have been studied perhaps more than any other British mammal. Yet there was more to be done. The growing appreciation of the oneness of an animal with its environment, animate and inanimate, demanded that a closer reckoning should be made between vital reactions and the condition or combination of conditions with which they were associated.

Dr. Darling has accomplished this "study of animal behaviour" with painstaking thoroughness and devotion. For two years he lived with the deer in the wilds of Wester Ross, following their movements and studying their activities at all seasons and under all sorts of conditions; as a result he has contributed and added precision to our knowledge of their natural history, and by emphasizing the relationship between weather and movement and the influences of communal life has opened up a new field of interest and speculation.

A main thesis developed in the book is the importance of the hind as a leader in the deer community: "the stag never attains to leadership, and the first stag in rut which may be running round a group of fifty hinds has no power of leadership"; but "the outstanding feature of the hind group is its cohesion which, doubtless, is derived from the stability of the family". Many telling examples are given of the supremacy of the leader hind in her own coterie, as controller in advance and retreat, as watch and ward; even in the harem of the rutting stag the hind still retains her leadership in spite of the "egocentric and casual dominance of the stag". To this social system in a gregarious community the author applies the term "matriarchal".

The analysis of the differences between the behaviour of stag and hind groups, of their selection and use of distinct territories, and of the influences of atmospheric moisture and wind upon herd movements are valuable contributions to the ecology and reactions of the red deer. Although physiological speculation has perhaps outrun the evidence, the factual description of the phases of reproduction and of their bearing upon the sociality of the species is thorough and suggestive.

The book appears to have been written somewhat hurriedly, and inaccuracies have crept into the text: poplar trees are not "relics of a golden age of pine forest" (p. 12) judging by pollen statistics, and the pine forest of the peat did not follow upon the last glacial period (p. 15); to state boldly that Rowan's experimental crows flew *northwards* (p. 155), when the majority did not, is somewhat distorting the evidence; the map of the distribution of red deer in Scotland (p. 28) omits the interesting colony in North Uist; and it seems inconsistent to state that "man has been at pains to breed out the social instincts" of sheep (p. 95), and on the following page to say that the primitive or wild type has no flocking instinct. Sometimes, too, assertion goes further than is warranted.

Dr. Darling's book is attractively written, and he has made out a good case for "taking sociality into account in observing and interpreting behaviour"; his work will remain an example of how such observation may and should be carried out in the haunts of a wild creature.

**(1) Spontane und Strahleninduzierte Mutabilität**
Von H. Stubbe. (Probleme der theoretischen und angewandten Genetik und deren Grenzgebiete.) Pp. 190. (Leipzig: Georg Thieme, 1937.) 6.80 gold marks.

**(2) Erbschädigungen**
Von Dr. Gerhard Schubert und Dr. Artur Pickhan. (Probleme der theoretischen und angewandten Genetik und deren Grenzgebiete. Herausgegeben von H. Böhm, G. Gottschewski, W. Hüttig, G. Just, A. Pickhan, W. F. Reinig, O. H. Schindewolf, H.Stubbe, N. W. Timoféeff-Ressovsky, F. von Wettstein, K. G. Zimmer. Redigiert von W. F. Reinig.) Pp. 164. (Leipzig: Georg Thieme, 1938.) 6.80 gold marks.

THESE two volumes belong to a series dealing with the problems of theoretical and applied genetics.

(1) The first, by Dr. Stubbe, is a detailed account of spontaneous and induced mutations in animals and plants, but with the main emphasis on X-ray mutations. The results in this field are carefully analysed, and the methods used in such work are described, especially as regards dosage and length of exposure. The book will be useful for reference by all workers in this subject.

(2) The second volume, edited by medical workers, covers part of the same ground as the first. Beginning with introductory chapters on the groundwork of genetics and the nature of mutations, the third chapter discusses the genetics of wild populations in relation to isolation and selection. Chapters iv and v are concerned with the production of mutations by various types of radiation and by other physical and chemical means. The concluding chapters discuss the genetic bases of germinal injuries and defects, with particular reference to conditions in man. The mutation frequency in man and the relative importance of different types of radiation therapy are considered.

**Pascal**
The Life of Genius. By Morris Bishop. Pp. xii+398+6 plates. (London: G. Bell and Sons, Ltd., 1937.) 12*s*. 6*d*. net.

WE have very few books in English about this great French thinker, who has always had an extraordinary following on the Continent. Prof. Bishop's study is therefore most welcome. The various aspects of Pascal's personality are studied in turn: a thinker, a mystic, a philosopher, a physicist, a mathematician, a theologian, a man of the world, Pascal had many interests and must be credited with many achievements. These, however, are not considered quite so eminent by the author as to justify the usual estimate of Pascal's genius as one of the first rank. In science, in particular, Pascal did not do so much as some other of his contemporaries: by stressing the importance of intuition, with due regard to the claims of experience in physics, and of formalism in mathematics, it would appear that Pascal was ultimately concerned more with religion than with positive knowledge.

The attraction of man towards the infinite is, indeed, the mainspring of Pascal's thought: his theories and thoughts are really illustrations of this leading conception of man's destiny. Prof. Bishop is therefore right in suggesting that Pascal's work is more significant for the history of religious thought than otherwise. In this respect, he rightly sides with the Jesuits against the Jansenism of Port-Royal. In spite of the light thrown by the author with excellent scholarship on Pascal's personality, the impression remains that Pascal emerges rather smaller from this scrutiny. But this, of course, is not the wish of the author of this excellent work.

T. G.

**Lac Cultivation in India**
Being a second and revised edition of "A Practical Manual of Lac Cultivation". By P. M. Glover. Pp. vii+147+25 plates. (Namkum: Indian Lac Research Institute, 1937.) 2 rupees.

IT is tolerably well known that lac is a resinous substance secreted by a scale insect (family Coccidæ) known as *Laccifer lacca* (Kerr.). The production of lac is virtually a monopoly of India and Burma. The greater amount of lac is produced in Bihar: outside India, lac is grown in small quantities in Ceylon, Java, Borneo, Malay States, Siam, China and Indo-China.

A great deal of biological and practical work respecting lac and the lac insect has been carried out at the Indian Lac Research Institute at Namkum, Ranchi, Bihar. The results of this work are embodied in this book, now under notice, written by Mr. P. M. Glover, entomologist to the Institute. Its first edition appeared in 1931 but, since that time, conditions affecting the lac industry have changed very considerably including, more especially, the plantation growth of lac. The whole subject is very comprehensively treated by Mr. Glover, particularly from the cultural and commercial points of view, while essential knowledge regarding the biology of the insect and of its parasites and predators is not overlooked. The book is well printed and fully illustrated, while its low price should ensure its continued success.

A. D. I.

**The California Woodpecker and I**
A Study in Comparative Zoology. By William Emerson Ritter. Pp. xiv+340. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1938.) 16*s*. net.

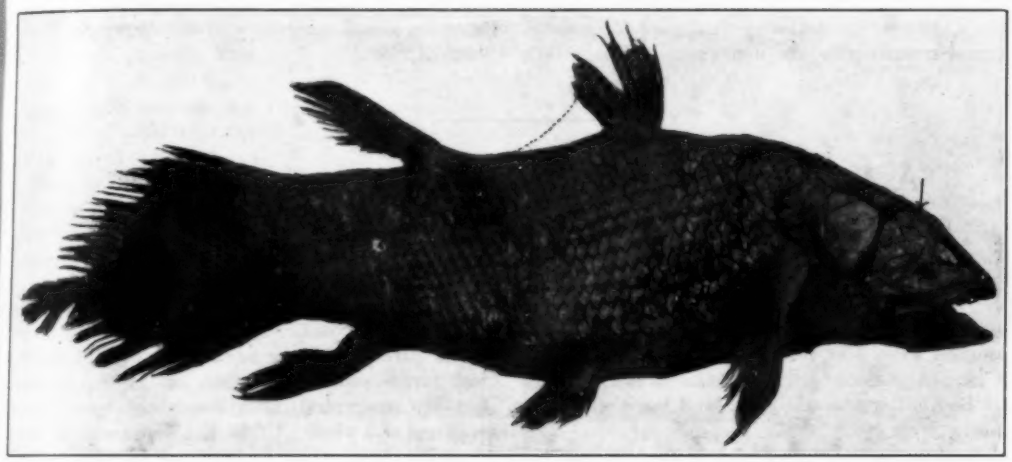
THE acorn-storing of the California woodpecker is of great interest, as storage of food for use at a distant date is very rare among birds. The woodpecker drills holes in the bark of a tree, and fits an acorn tightly into each—big end outward. Sometimes the natural corrugations of the bark are used, or the cracks in a telegraph pole. The drilled surface often becomes covered with a mosaic, of perhaps 50,000 acorns on a single trunk. This behaviour provides the starting-point of the present study, and the first part of the book is mainly ornithological. It then forms the basis of an essay in comparative zoology and psychology, in which bird and man are contrasted, and leads finally to a philosophical discourse under the caption "My Understanding of Men and Woodpeckers".

# A Living Fish of Mesozoic Type

By Dr. J. L. B. Smith, Rhodes University College, Grahamstown

EX *Africa semper aliquid novi*. It is my privilege to announce the discovery of a Crossopterygian fish of a type believed to have become extinct by the close of the Mesozoic period. This fish was taken by trawl-net at a depth of about 40 fathoms some miles west of East London on December 22, 1938. It was alive when caught, and shortly after it died it was handed over to Miss Courtenay-Latimer, curator of the East London Museum. Miss Latimer wrote to me, enclosing a sketch and brief particulars of the specimen. Owing to the seasonal disorganization of the postal services, the letter did not reach me at Knysna, some four hundred miles away, until ten days later. It was obvious from the sketch and notes that the fish was of a type believed long extinct. Immediate telephonic communication with the East London Museum revealed that, owing to lack of preserving equipment at that Institution, the putrefied body had been disposed of beyond any hope of redemption, and the fish had been mounted by the local taxidermist.

Since the fish was unquestionably alive when caught, there is at least a possibility that this zoological tragedy may be ameliorated by the capture of another specimen. This is not so remote as might appear. After careful inspection of the mounted specimen, a responsible citizen-angler of East London stated that about five years ago he had found precisely such a fish, only considerably larger (*sic*), partially decomposed, cast up by the waves on a lonely part of the shore east of East London. When he returned with assistance, the monster had vanished with a risen tide. With regard to the present specimen, fortunately both Miss Latimer and the taxidermist were drawn to observe details of the carcass very closely, so that exhaustive independent questioning has left me with at least some definite information about the missing parts. Fortunately also, the terminal caudal portion of the vertebral column and part of the pectoral girdle remain. The skull is of course intact.



COELACANTHID FISH FROM EAST LONDON, SOUTH AFRICA.
The small arrow shows the position of the spiracle, and the dotted line indicates the position of a membrane behind the first dorsal fin.

The specimen is 1,500 mm. in total length, and weighed 127 lb. when caught. The colour was a bright metallic blue, which has faded to brown with preservation.

In major characters this remarkable specimen shows close relationship with the Mesozoic genus *Macropoma* Agassiz, of the family Cœlacanthidæ, order Actinistia. The gephyrocercal tail with protruding axial supplement, the normal first dorsal, the obtuse lobation of the remaining fins, the ganoin tubercle ornamentation on the scales and on some of the dermal bones of the head, the

nature and arrangement of the dentigerous bones of the mouth, and the form of the dermal armour of the head, are all typically cœlacanthid.

The skeleton was cartilaginous, the vertebral column apparently tubular, and the whole fish extraordinarily oily. The fish has small spiracles situated as shown in the accompanying illustration, and a definite though not very obvious lateral line, which continues uninterrupted to the end of the supplementary caudal. Other differences from the known cœlacanthid fishes are the pronounced pedunculation of the lobate pectorals, the reduction of the dermal armour of the head, and the presence of two small heavily ornamented bones at the anterior lower corner of the opercular plate, which probably correspond with the more fully developed inter- and sub-opercula of teleosts, also a similar posterior post-spiracular ossicle. Dermal parafrontals are not visible. There is a free tongue composed of four fused segments covered with presumably ossified tubercles.

It is probable that systematists will wish to propose a new family (some even a new order) for this fish, but I am at present satisfied that it is close enough to the Mesozoic Cœlacanthidæ to justify its inclusion in that family. It has been noted that certain cœlacanthid fishes underwent little apparent change from the Devonian to the Cretaceous. It is therefore not surprising that this species, which presumably has survived from the Mesozoic, should still retain most of the features which characterize that family.

For the fish described and figured above I propose the name *Latimeria Chalumnæ* gen. et sp. nov.; the full account of the species and of its taxonomic relationships will be published in the *Transactions of the Royal Society of South Africa*.

---

# A Tentative Land Fertility Map of England and Wales*

By Dr. L. Dudley Stamp,
Director of the Land Utilisation Survey of Britain

INDUSTRIAL and housing development in England and Wales is estimated to have absorbed since 1900 no fewer than 800,000 acres—an area equivalent to the counties of Buckingham and Bedford combined. This land has been taken mainly from that devoted previously to agriculture and, once covered with bricks and mortar, it is lost to agricultural production for ever. Not only is the area concerned 2 per cent of the total area of the country, but it is also largely the best quality land. The modern factory with its horizontal layout requires level or gently undulating land, preferably well-drained; such land is also that most easily and cheaply developed as building estates and is also of the type required for aerodromes. It is precisely the best ploughland which has these characteristics and which is therefore being absorbed with alarming rapidity. Amongst the assets of the nation, its good agricultural land is surely one of the most precious, and yet, at the present time, enjoys little or no protection.

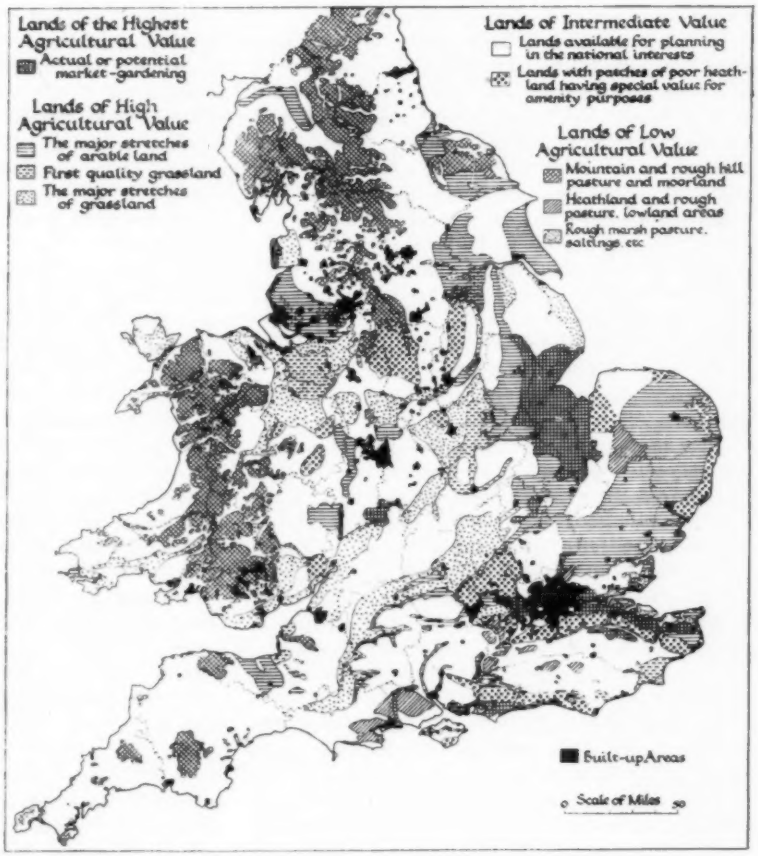
First-class arable land, suitable for intensive use as market gardens, occupies a strictly limited area in Britain—probably not more than 5 per cent—yet the value of even this land for agricultural purposes is below its 'development' value if it is so situated as to be suitable for housing or industrial purposes. Similarly, local and other public authorities take such land without hesitation for housing, recreation or public utilities (notably reservoirs), thus impoverishing national resources as a whole. Under the Town and Country Planning Acts, most agricultural land is 'zoned' for housing independently of its value for food production. Indeed, many town and regional plans completely ignore agricultural values and, as in the case of the South Essex regional plan, would result in the best land being devoted to housing and industry before the poorer land is touched. It is becoming increasingly apparent that, in the matter of land planning, local and national needs are in direct conflict, and that a National Planning Board is an urgent necessity.

If the national stability depends in any way on the maintenance and perhaps increase in home food production, and if the national health can be related in any way to a supply of fresh milk, vegetables and fruit, then the appropriate land must be preserved. The determination of the areas of best land thus becomes a problem of greatest urgency.

Several different bases might clearly be adopted in attempting a classification of the land of Britain. It might be made on the basis of a detailed soil survey, but this has not yet been made and there remain technical difficulties, including both finance

* Summarized, by permission, from a report prepared at the request of the Royal Commission on the Geographical Distribution of the Industrial Population and included in a public lecture delivered at the London School of Economics on January 31.

and personnel. Another method is to take agricultural productivity, but this is only valid if crop yields are studied on a field-to-field basis or carrying capacity of grassland on similar small units. Conclusions based on statistics available—even if individual farm or parish figures are used—are far too generalized because of the inherently heterogeneous character of the units. A survey of land values at a given time might seem to indicate a suitable basis were it not that these are related too closely to considerations of accessibility and to amenity or 'development' values. In a country where natural or semi-natural vegetation is still dominant an ecological survey may well, as F. E. Clements has urged, assess the combined total influence of all natural factors—of elevation, aspect, drainage, soil, climate. This method can be applied to the great moorland and 'rough grazing' areas of Britain and has been extended by Stapledon and his co-workers to the whole of Wales by using 'index species' and the floristic composition of the widely distributed grassland.


Lands of the Highest Agricultural Value
Actual or potential market-gardening
Lands of High Agricultural Value
The major stretches of arable land
First quality grassland
The major stretches of grassland
Lands of Intermediate Value
Lands available for planning in the national interests
Lands with patches of poor heathland having special value for amenity purposes
Lands of Low Agricultural Value
Mountain and rough hill pasture and moorland
Heathland and rough pasture, lowland areas
Rough marsh pasture, saltings etc
Built-up Areas
Scale of Miles 50

It is possible to devise a classification based primarily on existing land use provided that natural, historical and economic factors are all adequately considered. The Land Utilisation Survey has completed a field-to-field survey of present land use over the whole of England, Wales and Scotland. The six-inch field maps and the one-inch coloured maps (of which eighty sheets have now been published) form the starting point for comparison with the past. Over large areas of the country, a direct comparison can be made with the period 1837–1845 by plotting on to modern six-inch maps the information collected in parish surveys made under the Tithe Redemption Act of 1836—a tedious and laborious though illuminating exercise. In some areas, eighteenth century enclosure, manorial and other medieval maps carry back the story much farther. Contrary to popular belief, the natural factors exercise a greater influence now than they did in the past in the determination of land use. With the improvement of internal communications and the development of overseas supplies, it is no longer economic to use land for the production of commodities (such as wheat in much of the West and Midlands) for which it is, for climatic or edaphic reasons, unsuited.

Most of Britain has been settled and farmed for hundreds, if not thousands, of years. Recent land-use is often the result of a long continued process of determination by trial and error. Our investigations have stressed what might therefore be expected, though which is constantly denied, that there is a remarkable stability of land use in Britain. This applies to the poorest land—moorland and wasteland now and in the past; and to the best land—selected for ploughland in the past and remaining under the plough to the present day despite economic vicissitudes. The maximum of change has taken place on lands of intermediate

quality—under certain economic conditions it may pay to plough them; under others to put them down to grass; under others to abandon them entirely or in part.

Thus the classification of the land of Britain now proposed is based on a variety of considerations. The accompanying map is a first attempt to show the approximate distribution of each type. It has been prepared on incomplete information and is published now for the first time in order to secure constructive criticism.

(1) *Land of the highest agricultural value—actual or potential market-garden land*, capable of intensive cultivation, with deep, fertile, easily worked loamy soils, retentive of moisture and of manure and often naturally rich in humus and mineral salts. Most of this land has long been tilled, though some (for example, Fenland and south Lancashire) has been made available by careful drainage. This is the land above all other needed by the nation for the production of fresh fruit and vegetables, and which needs protection from the inroads of housing and industry. Its protection near towns is especially desirable to secure local supplies of fresh vegetables. Some at least might be reserved for allotment gardens.

(2) *Land of high agricultural value—the major ploughlands.* For climatic reasons this land is mainly in eastern and southern England and is the land from which Britain must obtain the bulk of her ordinary farm crops for direct human consumption. Whilst from its position and character some may be needed for aerodromes and other national requirements, it should be protected so far as possible from housing and industrial development. Most has shown great stability in use as crop land.

(3) *Land of high agricultural value—first quality grassland.* This includes the best 'fattening pastures', capable of fattening one bullock per acre (or equivalent in other animal units) and usually managed as permanent grassland. Soils are often heavy though fertile and surface water is available. The land is the basis of the home-killed beef industry and much of the dairying industry and should be preserved as far as possible.

(4) *Land of high agricultural value—the major stretches of good grassland.* The carrying capacity is lower than on the first quality grassland and the pastures are not normally fattening pastures without the aid of auxiliary feeding stuffs. The land should be regarded as primarily agricultural but not debarred from other uses under adequate safeguards or control.

(5–7) *Lands of intermediate value.* In the present state of information available no attempt has been made on the map to subdivide this land, though clearly two or three major types can be separated; for example, the broad stretches of downland, normally under mixed farming, contrasting with the hilly lands of western England and Wales under alternate husbandry. Quite apart from detailed soil studies (the soils are extremely varied) most of this land can be detected when its utilization is studied historically. Much of it to-day is under pasture (often of second quality with reeds, rushes, bracken, etc.); in past times of prosperity or under economic stimulus, much of it was ploughed and cropped; with the advent of times of depression, it became in part agriculturally sub-marginal and much is allowed to lie idle. This is land which should be the especial concern of national planning, where an integration of agriculture, housing, industry, including garden cities, recreational areas, high-speed parkways and other requirements of present and future, should really be planned.

(8) *Land of low agricultural value—moorland and rough hill pasture.* This is land with immature mountain soils, usually thin, or stony podsolized soils, which is of limited economic value as rough grazing, as sporting estates or as gathering ground for water supply. Because of its hilly or mountainous character it is rarely suitable for industrial development, but its greater use in the national economy can be found by a careful division into areas suitable for (*a*) improvement to good pasture, (*b*) afforestation, (*c*) recreation (national parks, etc.), (*d*) water supply and (*e*) rough pasture as at present.

(9) *Land of low agricultural value—heathland and lowland areas of rough pasture.* These are the old 'wastelands' of the medieval farmer, usually with 'hungry' light soils, and most of the 'commons' of south-eastern England, as well as larger areas such as the New Forest and Breckland, are of this type. Where occurring near towns, this land is ideal for those parts of 'green belts' designed primarily as public open spaces—scenically attractive with heather and pine woods and drying quickly after rain. If abundant (for example, parts of Surrey) the land is very attractive for good types of residences, provided the owner does not look for a substantial return from the cultivation of his garden or small-holding. The more extensive or remote areas are suitable for coniferous afforestation, military training grounds, and even in some areas for industrial purposes.

The driest and least fertile tracts of downland and limestone pasture are allied in value and utilization; for example, parts of the Chilterns and South Downs.

(10) *Land of low agricultural value—rough marsh pasture, saltings, etc.* Although the reclamation of such land often provides good grazing

(Thames marshes) or even good arable land, it is expensive and difficult to justify commercially; on the other hand, the waterside location, ease of excavation for docks, wharves, etc., and the possibility of building up the land by dredging silt from neighbouring watercourses and thus improving the river channels, makes this cheap land attractive to heavy industry. There is every reason to encourage industry to use such land; for example, Tees-side, Teesmouth, Thames-side, banks of Lower Medway, certain parts of Southampton Water, etc.

---

# National Nutrition Policies

By Sir John Boyd Orr, F.R.S.

IT has been known for many years that faulty diet is the direct cause of a heavy mortality throughout the world through deficiency diseases such as pellagra and beriberi, and, even in the wealthiest countries, of a great deal of ill-health. It has also been known that diseases due to faulty diet are possibly the easiest of all to prevent. Yet we are only now beginning to make a survey of the extent of the damage being done to the human race by malnutrition, and of our food resources available to prevent that damage.

Through the action of the League of Nations, this is now being done on an international basis*. Following the recommendation of the League's Mixed Committee on Nutrition, twenty-one countries have set up national nutrition committees to collect information regarding the state of nutrition in the different countries and to ascertain what is needed to make national dietaries fully adequate for health. The committees are conducting inquiries on what foods and what amounts of each are consumed by people of all classes and living under all sorts of conditions. This information, got by family budget inquiries and dietary surveys, enables estimates to be made of the nutritive value of the diet of different classes and also gives an indication of the level of income necessary for adequate nutrition. A parallel investigation of the state of nutrition of the families whose diets are determined will give some indication of the extent to which ill-health and poor physique can be attributed to deficiencies in the diet.

It is difficult, however, to assess the relative influence on health of faulty diet and of other factors inimical to health which usually accompany faulty diet. Useful information on this can be obtained by feeding experiments on children on poor diets, the deficiencies of which are made good by the addition of supplements of high nutritive value, and comparing the subsequent health of these children with that of children on similar diets and under comparable conditions but not receiving supplementary feeding. A further line of inquiry recommended is a survey of total national food supplies, home products plus imports, and a comparison of total food available with total national nutritional requirements. The information obtained in all these investigations will show what changes are needed in national food policies in the interest of health.

Governments were requested to furnish to the League annual reports on the work of their nutrition committees and the secretariat was instructed to publish an annual summary of these statements and of the proceedings of meetings of the representatives of the national committees. This survey of national nutrition policies now available gives the first annual report on the statements received and of the proceedings of the first meeting held last October, at which sixteen countries were represented.

Though the work of most of these committees is still in the initial stage, this report promises well for the success of the difficult work which they have undertaken. The information brought out in the preliminary inquiries shows the great need for a world-wide investigation and the immense possibilities of promoting human welfare by the application of "the newer knowledge of nutrition". The facts already revealed are sufficiently startling to warrant immediate changes in national food policies. Even in a country like Australia, where the standard of living is high compared with European countries, it was found that clinical survey with modern scientific methods revealed a quite unexpected amount of malnutrition. Of more than three thousand children examined in four inland areas, 17·9 per cent were recorded as showing evidence of unsatisfactory nutrition. An inquiry among pre-school children in Melbourne revealed evidence of malnutrition in 21·7 per cent of those examined. It is suggested that the malnutrition is due to a lack of dairy products, fruit and vegetables. The Australian Government has been trying to find a market for the export of these. It looks as if she has a market within her own borders which could be exploited to the great benefit of the people of Australia. In the United States, more than 60 per cent of the diets of Negro

* League of Nations. Survey of National Nutrition Policies, 1937-38. (Official No.: C.478.M.321.1938.IIA.) Pp. 120. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1938.) 2s. 6d.

families in the south were found to be in need of improvement. In Hungary it was found that if requirements are to be fully met and exports maintained at the present level, milk production would need to be increased by 120 per cent and eggs by 470 per cent. In Jugoslavia, the peasant's winter diet consists almost solely of bread and beans. In summer, it provides nearly all the necessary elements, with the result that, in the autumn, there is a noticeable improvement in nutrition. Under the existing economic conditions, the peasant is obliged to sell his milk and eggs, and farm workers and children suffer from all kinds of deficiency diseases. Rickets and pellagra are specially common. During the Easter fast, epidemics of night-blindness and other eye diseases occur in certain regions. It is stated that some villages observe practically all orthodox fasts, which may amount to as many as 206 in the year.

These are examples of the kind of facts being brought to light by the work of these national nutrition committees. They are dealing with an urgent world-wide problem. They are showing the direction in which modern science can be most easily applied for the promotion of human welfare, provided Governments can devise ways and means to increase production of the 'protective' foods, to facilitate distribution and adjust the economic system to bring a diet adequate for health within the reach of all and, at the same time, carry on educational campaigns so that families may be able to adjust their expenditure on food to the best advantage.

The work which the League of Nations has done in initiating and carrying on this work for the improvement of nutrition on an international basis is sufficient alone to justify its establishment. The League provides an international organization which can mass the world's scientific knowledge on the problem, and bring together the representatives of all the different countries once a year to get the mutual benefit of the exchange of information and the discussion of difficulties. The enthusiasm for the work would be increased with the knowledge that the information obtained is being used for the evolution of agricultural, trade and economic policies, designed to adjust national food supplies to national requirements and so bring the work of the national committees to full fruition.

---

# Element 43

By Prof. E. Segrè

EVERY time that physics has offered a new analytical tool to chemistry, the most striking success has been the discovery of new elements. Rubidium and cæsium are thus offsprings of the use of the spectroscope, polonium and radium were discovered through the new methods of radioactivity, hafnium and rhenium were recognized through their X-ray spectra.

Mendeléeff's work, on the other hand, by classifying the chemical types, has in a way set a limit to the possibility of further discoveries and gives also a method of predicting rather exactly the properties of the missing elements. These are element 43, a lighter homologue of rhenium; element 61, a rare earth; element 87, a halogen; and element 89, an alkali. The search for these elements in the minerals, the only source at our disposal until a few years ago, has not been successful, and none of them seems to have been recognized with certainty in the earth's crust, in spite of considerable effort[1].

Artificial radioactivity has supplied chemistry with a powerful new instrument, and from the point of view of the discovery of new elements its most striking feature is that one is able now to create, by transmutation from other elements, the element one wants to study. The first achievement in this type of investigation was the discovery of transuranic elements by Fermi and his co-workers, continuing the periodic system above uranium (No. 92), although, in view of recent work, confirmation of their existence is needed.

In the search for the four missing elements lower than uranium, we have now been able to prepare element 43 and study its properties in detail. The substance was produced in the Berkeley cyclotron, which thus remains for the time being the only 'mine' of the element. It was made by bombarding molybdenum with deuterons or with neutrons[2].

At least five radioactive isotopes of atomic number 43 have been recognized[2] among the products of the bombardment, and some of them have a half-life long enough to permit a rather complete investigation of the chemical behaviour of element 43. Actually perusal of the periodic table may help to predict many of its chemical properties but, on the other hand, the finer details, often very important from the analytical point of view, may be found only by direct experiment.

The first properties to be studied obviously should be the analytical ones, in order to be able to identify the new element and separate it from all the others. Many of the separations are quite

elementary and there is no need of any special study to devise them, but for the separation from the neighbouring elements things are more complicated, and emphasis has to be put on the separation from manganese, molybdenum, ruthenium and especially rhenium, which are the four elements closest to element 43 in the periodic table, and have most resemblance to it. The methods and principles of the chemistry of minute amounts of substance and of radioactive detection, as worked out by Curie, Rutherford, Soddy and others in their classical work on the natural radioactive elements, have been employed throughout and satisfactory methods of separation have been worked out. The fundamentals of the analytical chemistry of this element have thus been secured and can now be utilized for further progress.

Practically none of the many physical constants of the new element can be determined using amounts of the order of magnitude of $10^{-10}$ gm. of substance as produced artificially; but this situation prevails also for some of the natural radioactive substances, and there is at present no possibility of overcoming this difficulty. On the other hand, properties such as the volatility of certain compounds, partition coefficient in fractional crystallization, etc., can be determined even with such tiny amounts of substance, and some of these have actually been measured.

A fortunate circumstance allows us to detect even the $K_\alpha$ line of the X-ray spectrum of element 43, though the amount of substance would not be sufficient to show, by ordinary methods of external excitation, this spectral line, or any optical line. One of the radioactive isotopes of 43 exists in two isomeric states and the upper state decays into the lower. By the mechanism of internal conversion of the gamma rays, these transitions eject the $K$ electron of the atom 43, which is now in a condition to emit the characteristic X-ray line. This line has been identified by its absorption discontinuity in neighbouring elements[4], and more recently it has even been possible to photograph it in a bent crystal spectrograph[5]. This is the first time that the X-ray line of a new element, synthesized artificially, has been directly observed.

[1] See, however, Noddack, W., and Tacke, I., *Sitzb. Preuss. Akad. der Wissenschaften*, **19**, 400 (1925).
[2] Perrier, C., and Segrè, E., *J. Chem. Phys.*, **5**, 712 (1937); and in the Press.
[3] Cacciapuoti, B., and Segrè, E., *Phys. Rev.*, **52**, 1252 (1937); and unpublished results.
[4] Segrè, E., Seaborg, G. T., *Phys. Rev.*, **54**, 772 (1938).
[5] Abelson, P., unpublished results

# Obituary Notices

## Prof. Henry Louis

THE death of Prof. Henry Louis at his home in Newcastle-upon-Tyne on February 22 at the age of eighty-three years marks the passing of a period in the life of the Royal School of Mines, as he was the last survivor of the students who were present at the first annual dinner held in 1873.

Louis was born in London, and after receiving his preliminary education in London and Germany entered the Royal School of Mines in 1873, where he studied mining under Warington Smyth and metallurgy under John Percy. He became remarkable for the wide scope of his learning, and won fame as a mining engineer, a metallurgist, a teacher and a linguist.

After graduating first of his year, Louis worked for some time in Percy's laboratories and then commenced his professional work in association with Sir William Siemens. For twenty years he was entirely engaged in reporting upon and managing metalliferous mines in different parts of the world, including South and West Africa, South and North America, Malaya, California and Spain. Thus his knowledge of mining practice became almost encyclopædic.

During this period, Louis never lost his early interest in primary metallurgy, both ferrous and non-ferrous, so that when he was appointed to the joint posts of professor of mining and William Cochrane lecturer in metallurgy in Durham College of Science, Newcastle-upon-Tyne, now King's College, Newcastle-upon-Tyne, in 1895, there could have been no more fitting choice. As a teacher he was outstanding. His personality impressed itself on his students and inspired them in a remarkable way, his fund of knowledge and experience being a perpetual source of joy to all those who had the good fortune to work under his direction.

Louis was the author of many publications, in which the breadth of his knowledge is admirably displayed. While he was a persistent and usually kindly critic of the work of his fellows, his comments at times could be devastating. He took a very active part in the life of many professional institutions and was elected president in 1927 of the Institution of Mining Engineers, and in 1929 of the Iron and Steel Institute, which awarded him the Bessemer Gold Medal in 1932. A year later he was elected a fellow of the Imperial College.

The last forty years of Louis' life centred around the northern coalfield, where his work as professor and emeritus professor, as well as his twenty-five years' association as secretary, with the North of England Institute of Mining Engineers will long be remembered. He was a member of various Government Commissions, of which two—the Royal Commission on Mining Subsidence, 1923–1927, and the Commission to inquire into the practicability of gold mining in Merionethshire, 1930—were of particular interest to him. J. A. S. RITSON.

## Dr. W. E. Grimshaw, O.B.E.

THE Research Department, Woolwich, has suffered a serious loss through the untimely death of Dr. W. E. Grimshaw, deputy director of ballistics research, at the age of fifty-eight years.

Dr. Grimshaw originally joined the department in 1916 as an assistant proof and experimental officer, remaining at Woolwich until September 1919, and then left to resume his pre-War employment as one of His Majesty's inspectors under the Board of Education. He rejoined in 1921 and at once took a leading part in the investigations into fundamental ballistic problems which had, of necessity, to be kept in abeyance during the War period. For this work he was peculiarly fitted as he could combine his wide knowledge of mathematics and physics with the practical artillery experience gained during his War service.

A long series of researches, experimental and theoretical, on the burning of propellants in a closed vessel culminated in the joint publication with Dr. A. D. Crow of two important papers, "The Equation of State of Propellant Gases", (*Phil. Trans. Roy. Soc.*, A, **230**; 1931) and "The Combustion of Colloidal Propellants" (*Phil. Trans.*, **230**; 1932). The first paper greatly extended Petavel's early work on the subject (*Phil. Trans. Roy. Soc.*, A, **205**; 1905) while the second put forward the theory that the rate of burning of a propellant (such as service cordite) is conditioned by the density of the surrounding gases rather than by their pressure (Cf. Mansell, *Phil. Trans. Roy. Soc.*, A, **207**; 1908). The mathematical consequences of this theory as applied to internal ballistics were examined in two further papers, with Dr. Crow, on "The Combustion Problem of Internal Ballistics" (*Phil. Mag.*, **15**, 529, 729; 1933).

Another problem to which Grimshaw turned his attention was that of the behaviour of plastic metals under stress. The determination of the maximum gas pressure in a gun is a matter of great importance for ordnance design, and the service (crusher-gauge) method is to measure the amount of compression experienced by a small copper cylinder enclosed in a steel container fitted with a piston. This gauge, whilst giving reliable comparative results, is known to record less than the true pressure by amounts which vary with the nature of the gun and propellant employed. Grimshaw examined the problem afresh in his paper "The Plastico-Viscous Deformation of Right Circular Cylinders of Soft Metal under Variable Load Axially Directed" (*Phil. Trans. Roy. Soc.*, A, **233**; 1934), and intended afterwards to make practical use of the theory developed therein. The foregoing papers represent only a portion of his work, as it must be remembered that much of it had, of necessity, to remain secret; but it may be said that there was not one of the many and various problems connected with ballistics to which he did not make some contribution.

Grimshaw's earlier career at Oxford had been a brilliant one. A scholar of Corpus Christi, he took first classes in the Final Honour Schools both of mathematics and of physics, and he was junior and senior mathematical scholar of the University graduating B.A. in 1904 and M.A. in 1907. The degree of D.Sc. was conferred on him in 1936, and he was a foundation fellow of the Institute of Physics. His duties as an inspector of schools gave him no opportunities for research, but he got his chance in later life, although of recent years the burden of administrative work left him little but his leisure time for investigation. He had a very wide knowledge of modern mathematical physics and kept abreast of the times by incessant reading.

To his younger colleagues, Grimshaw was always generous with encouragement and help, and was consulted by them in any difficulty as a matter of course. He will be greatly missed as a most valuable member of the Research Department, and as a very loyal friend.

C. A. C.

---

## Dr. G. H. Carpenter

THE REV. DR. GEORGE HERBERT CARPENTER died at Guildford, Surrey, on January 22, at the age of seventy-three years. Born at Peckham in 1865, he was the son of George Carpenter and Phoebe Hooper. His early education was private; later he carried on his studies at King's College, London, and at the Royal College of Science, Dublin. After a period as clerk in the Natural History Museum, South Kensington, he became, in 1888, assistant naturalist at the Dublin Museum. He gave up this post in 1904 on being appointed professor of zoology at the Royal College of Science (Dublin), where he stayed until 1922. On leaving Ireland he became keeper of the Manchester Museum (1923–34). A few years after his return to England he became a deacon of the Church and a priest a year later. He was honorary curate at Christ Church, West Didsbury, from 1926 until 1934 and was transferred to a similar position at St. Augustine's, Broxbourne, from 1935 until 1937. He was editor of the *Irish Naturalist* for thirty years, secretary of the Royal Zoological Society of Ireland from 1911 until 1919 and afterwards secretary of the Royal Irish Academy.

Most of Carpenter's published work was in connexion with entomology. Of his books, "Insects, their Structure and Life", first published in 1899, is an admirable elementary manual. This was followed by his "Insect Transformation" (1921) and the "Biology of Insects" (1928), both of which are characterized by accuracy and clearness of exposition. He made a special study of the order Collembola and became the leading authority on this group in Great Britain. On the morphological side, he was specially interested in segmentation among arthropods and wrote several papers on this topic which were noteworthy in their day. For a number of years, he was consulting entomologist to the Royal Dublin Society, and in this capacity wrote a series of reports on injurious insects in Ireland. He was especially interested in the warble fly problem, and on this subject he contributed valuable papers based on carefully planned experiments.

Carpenter's death removes from our midst a kindly and generous personality. He is survived by his wife and son.

A. D. I.

## Dean L. P. Reinhold Matsson

THE death last summer of Dean Reinhold Matsson, botanist, geneticist and churchman, at the relatively early age of sixty-eight years, is a distinct loss to rhodology and systematic botany in Europe.

Since the time of Linnæus, there has been a traditional line of systematic botanists in Sweden—Afzelius, Swartz, Hartman, Wahlenberg, Fries, Scheutz, Winslow, Almquist and Matsson—who have worthily upheld the torch first lighted by the Swedish father of systematic botany. The last two, Sigfrid Almquist and Dean Matsson, both specialized in the genus *Rosa*, and although their methods were so original and diverse from one another, their results were complementary.

Dean Matsson had the good fortune to be born on the famous island of Gotland and to attend school in the medieval town of Visby, well known as the 'city of ruins and roses'. The abundance of wild and naturalized roses in the district no doubt attracted the natural curiosity of a born researcher like Matsson who, though destined for the church, was by nature a naturalist and man of science. At the University of Uppsala he happily combined the studies of theology and botany, and at an early age, under the direction and supervision of the world-famous Belgian rhodologist, Prof. Crepin, he made a thorough study of the genus *Rosa* and afterwards continued his researches on his own original lines. His first scientific paper was published in 1895 after two years' research in Gotland, Oland and Smaland, followed by papers in 1900 and 1901.

In the latter year, Matsson achieved a European reputation by his conspectus of *Rosa* in Neuman and Ahlfvengrens' "Flora of Sweden". Further contributions appeared in 1912, 1915 and 1916, culminating in his *magnum opus* of 1934–35, "Examen Rosarum Sueciæ", published in *Kungl. Svenska Vetenskapsakademiens Handlingar*, **14**, No. 3, pp. 1–380 (1934), Stockholm. In the course of his numerous collections, Matsson accumulated an extensive herbarium of valuable rose material. Like all practical botanists, Matsson was an enthusiastic gardener and geneticist, and in his gardens at Hudiksvall, in the Province of Halsingland, he cultivated and experimented genetically with the forms of *Rosa* collected in his expeditions. In 1912, his remarkable genetical experiments in breeding various species of Caninæ true to type, after the flowers had been carefully castrated, demonstrated, for the first time on a large scale, the existence of apomixis in the Caninæ roses. This important fact, since confirmed genetically and cytologically, has led to the generally accepted theory of the hybrid origin of all the Caninæ species of *Rosa*.

Matsson also gave considerable assistance to Tackholm in identifying the material used by him in his important work on the chromosomes of *Rosa*, and he was fully alive to the advantages of combining genetical with systematic work.

As a systematic botanist, Matsson was more analytical than synthetical, and the permanent value of his systematic work lies in his minute and accurate analyses of the character-combinations of the multitudinous forms, varieties, subspecies, and natural hybrids of the Caninæ species of *Rosa*.

C. C. HURST.

## Mr. C. H. Jenkinson

MUCH of the success of modern experimental research depends upon the quality of the instruments that are available, and it often happens that in the apportionment of credit for work done, the share of the workshop is comparable with that of the laboratory. Mr. C. H. Jenkinson, who died on March 6 after a short illness, was one of those artistic instrument-makers to whom science is in debt. He was trained in the works of the Cambridge Scientific Instrument Co. Nearly thirty years ago, he was given charge of the physics workshop of the University of Leeds. He made the first X-ray spectrometer. As the X-ray analysis of crystal structure developed and greater demands were made upon his skill, he never failed to respond, and to better the instructions given to him. Researches in various branches of physics, carried out at Leeds, at University College, London, and finally at the Royal Institution were greatly facilitated by his ingenuity in design, his judgment of material and his beautiful technique. In the reconstruction of the Royal Institution buildings his advice was of material value. He acted as a judge at the Physical Society's exhibitions in recent years. He will be sadly missed by the staff of the Davy Faraday Laboratory, and by all who are responsible for the effectiveness of the Royal Institution.

W. H. B.

WE regret to announce the following deaths:

Prof. Giuseppe Cesàro, formerly professor of mineralogy in the University of Liège, a past-president of the Belgian Academy of Sciences and *correspondant* for the Section of Mineralogy of the Paris Academy of Sciences.

Prof. H. M. Dawson, F.R.S., professor of physical chemistry in the University of Leeds, on March 11, aged sixty-three years.

Marcel Godchot, professor of chemistry and doyen of the Faculty of Sciences of the University of Montpellier and *correspondant* for the Section of Chemistry of the Paris Academy of Sciences, known for his work on the heterocyclic carbon compounds, on February 11, aged fifty-nine years.

Prof. A. M. Hocart, professor of social anthropology in the University of Cairo, on March 9, aged fifty-five years.

Dr. Ivan C. Jagger, senior pathologist in the Bureau of Plant Industry, U.S. Department of Agriculture, on February 16, aged forty-nine years.

Prof. C. M. Jessop, emeritus professor of mathematics in the University of Durham, on March 9, aged seventy-six years.

Prof. E. B. Wilson, For. Mem. R. S., Da Costa emeritus professor of zoology in Columbia University, on March 3, aged eighty-three years.

# News and Views

## Discovery of a Living Crossopterygian Fish

THE discovery of a living crossopterygian fish of the order Actinistia, described and illustrated on p. 455, is an event of outstanding importance. There can be no doubt that Dr. J. L. B. Smith, who is to describe this specimen, is correct in placing it in the family Cœlacanthidæ, of which it would appear to be a typical member. In some respects, the present specimen seems to bear a closer resemblance to genera of the early Mesozoic era such as *Undina* than to the later cœlacanths of the *Macropoma* type from the Upper Cretaceous. The fact that no traces of fossils referable to this family have been found in rocks later than those of the Cretaceous period makes the discovery of a living representative in South African seas even more remarkable. It is stated that the skeleton of the living fish was found to be cartilaginous and the vertebral column apparently tubular. In the fossils the central part of the vertebral column has disappeared, and was probably cartilaginous, but the neural and hæmal spines were ossified. A unique feature of the fossil cœlacanths is the ossified air-bladder, which can be seen clearly in many specimens, and it will be of interest to learn whether this character was observed in the living fish. The photograph of the South African fish seems to show paired nostrils just in front of the eye; but this is another feature of which we must await confirmation. Dr. Smith's detailed report will be awaited with great interest by zoologists and palæontologists alike, and it is little short of a tragedy that the unfortunate disposal of the body of the fish after skinning will make this report very far from complete. An article relating to the discovery of this fish by Dr. E. I. White, of the British Museum (Natural History), accompanied by a large photograph, appeared in the *Illustrated London News* of March 11.

## Prof. J. L. Myres, O.B.E., F.B.A.

ON October 1 of this year, Prof. John Linton Myres, Wykeham professor of ancient history in the University of Oxford, will retire, and will be succeeded by Mr. Henry Theodore Wade-Gery, fellow of Wadham College, Oxford. Prof. Myres has occupied this chair since its inauguration in 1910, returning to his own University after three years as Gladstone professor of Greek and lecturer in ancient geography in the University of Liverpool—a chair which also he was the first to hold. His tenure of the Wykeham professorship had already expired under the age limit, but was extended for a further period of five years. His appointment to this chair, which his pre-eminence as a research worker and original thinker in the field of the ancient history (or as it would now be termed the pre- and proto-history) and geography of the Mediterranean region had made almost inevitable, was otherwise appropriate in that he was both a Wykehamist and a member of New College.

BEFORE his appointment to the Gladstone chair at Liverpool, Prof. Myres had been a student of the British School of Archæology at Athens and had held a fellowship at Madgalen College and a studentship at Christchurch, Oxford; and he had travelled widely and excavated in various parts of the Mediterranean, Greece and the Ægean, Cyprus, Crete, northern Africa and Asia Minor—activities which have continued to occupy much of his periods of vacation. Apart from his reputation as archæologist, geographer, and historian—many of his discoveries and conclusions are classics of reference—Prof. Myres is known throughout the scientific world for his energy and abilities as an organizer. There are few fields in the economy of science in which he has not intervened to the advantage of men of science and their work. It was during his tenure of office as general secretary of the British Association in the years succeeding the Great War that the organization and working methods of that body were reformed and brought up to date, mainly on his initiative, with the co-operation of the late Prof. H. H. Turner and later of Sir Frank Smith, his fellow secretaries. During the War, Prof. Myres served in the Naval Intelligence in the eastern Mediterranean, where he combined the duties of an intelligence officer with more aggressive tactics, modelled, it was said, on the raids of Homeric heroes. For his services he received the O.B.E. and the Order of King George I of Greece.

## Early Civilization and Cultural Relations in Cilicia

EXCAVATIONS at Mersin in Cilicia by the Neilson Expedition to the Near East of the University of Liverpool during the present season have more than justified the anticipation of last year that this site would afford evidence of settlement and early cultural development equal in antiquity to, if not surpassing, anything yet recorded in the Mesopotamian region. According to Prof. Garstang's preliminary report on this season's work (*The Times*, March 10), the sixteenth level of excavation has been found to contain the well-preserved remains of a fortified city—a whole group of great buildings laid out with plan and purpose. This level lies twenty feet below the imperial Hittite fortress uncovered last year; and in it chalcolithic deposits lie beneath a stratified series of building levels, in which the culture is related to the early predynastic Mesopotamian cultures of Uruk and Tell Ubaid. The cultural affinity with predynastic Mesopotamia of the sixteenth level itself is demonstrated by evidence of direct contact with the polychrome phase of the still older Tell Halaf culture. Prof. Garstang's approximate dating assigning this cultural level at Mersin to 3600 B.C. is therefore to be regarded as by no means excessively high; while the line of fortifications with its abutting 'married quarters', and the chief's residence, all brick-built and not of stone, it is to be noted, thus constitute the oldest known example of architecture.

This level of chalcolithic occupation, however, lies at a depth of no more than 35 ft. from the summit of a mound which rises to a height of 80 ft. above water level; and it is known that there is a further ten feet of chalcolithic deposits below it before the neolithic strata are attained. In these, the accumulated relics of the original neolithic settlers extend downward for more than 30 ft. Here, Mr. Miles Burkitt, whose expert examination has been invoked, has found evidence, extending from below the painted pottery down to the 12 ft. level, of two main phases of neolithic culture, in which black or brown pottery is associated with tools of obsidian. To the beginning of the later of these two phases he assigns an antiquity which "can hardly be later than 5000 B.C., while the lowest level reached must date a thousand years earlier". As Prof. Garstang points out, the elaboration of the fortifications and dwelling site point to a well-advanced and highly organized existence at Mersin when Egypt, Babylonia, Crete and Europe were still in infancy. Impressive as the chronological range of this Cilician culture must appear to be, its significance for the archæologist is enhanced, when Prof. Garstang finds in certain details of his ceramic material evidence which appears to point not only to the East, but also to the West, forming a possible link with the Danubian area. Should further examination endorse this suggestion, Mersin will afford something approaching decisive evidence on a crucial problem of European prehistoric chronology of late much under discussion.

### Exhibition of Cypriote Antiquities

An exhibition of pottery of the Early Bronze Age at the Institute of Archæology of the University of London was opened by the Earl of Athlone, Chancellor of the University, on March 10. This pottery was excavated at Vounous in Cyprus by an expedition sponsored by the British School of Archæology at Athens and under the direction of Mr. James Stewart. The exhibition, as was pointed out by the Chancellor in declaring it open, is the first to be held in England of the results of an important excavation of purely British origin in Cyprus; and this fact is indeed of special significance in view of the attempts which have been, and are being, made to arouse interest in Great Britain in the early history and antiquities of Cyprus. The cost of the excavation was defrayed by subscription, among the principal subscribers being the University of Cambridge, Sir Charles Hyde, and Sir Charles Marston. The last-named has presented the main part of the finds allotted to him to the Institute of Archæology, and they form the nucleus of the present exhibition with supplementary loans from the Fitzwilliam Museum, Cambridge, and the Birmingham City Museum and Art Gallery. After the exhibition had been declared open Mr. Stewart gave an account of the site and its excavation. The Vounous site is a cemetery on the east and north sides of a low hill in the foothills of the Kyrenia Mountains. The north side had already been excavated by Dr. Dikaios, and the present work was confined to the east side. The tombs are open caves approached from a forecourt. Burial is in a contracted position, with burial gifts of pottery and food. The entrance was sealed with a single stone and covered in. Sometimes graves had been opened by an iron age grave-digger, who had again sealed the tomb after inserting a votive offering, with, as Mr. Stewart said, "confusing effect". The chronology of the site falls into three periods, dated tentatively from 2900–2500 B.C., 2500–2300 B.C. and 2300–2050 B.C.

### Approach to the Absolute Zero

The second Poynting Memorial Lecture in the University of Birmingham was delivered by Dr. H. B. G. Casimir, of Leyden, on March 7, on "The approach to the absolute zero of temperature and some properties of matter at the lowest temperatures at present attainable". Dr. Casimir remarked that the subject, being one in which the combination of the theoretical and experimental had been so fruitful, was an appropriate one with which to commemorate a man who had in himself so remarkably embodied this combination. The definition of temperature in terms of an ideal gas enables us to say that the ice-point is 273·15° K., but in practice the gas scale cannot be used directly below 1° K., for at such temperatures gases cease to exist. It is possible, however, by other methods, for example, the resistance of phosphor bronze, to extrapolate to 0·2° K., and very small temperature changes can be measured by using the magnetic properties of substances, so that measurements down to a few hundredths of a degree absolute or even less can be made with a good deal of confidence. Methods of experimenting were explained and the remarkable properties of helium II were described.

It appears likely that it is impossible to solidify helium II, because the solid state requires stability of lattice, and if the helium atom cannot have less energy than $h\nu/2$, this may be sufficient to prevent the formation of a stable lattice no matter how low the temperature. Some special advantages of working at low temperatures were mentioned: Electric insulation is enormously improved; exceedingly high vacua can be attained—if care is taken to exclude helium, vacua down to $10^{-10}$ or perhaps $10^{-15}$ mm. of mercury can be attained. Thermal insulation is greatly improved by the almost complete absence of radiation and of gas. Calorimetry is rendered relatively easy, for heat capacities are small, whereas by using the magnetic properties of a salt such as $KCr(SO_4)_2.12H_2O$, temperature changes of the order of 0·001° can be measured, so that the surprising conclusion emerges that the heat generated by allowing a mass of 1 gm. to fall through 0·01 mm. would be capable of detection. The facts of superconductivity suggest the possibility of construction of galvanometers of prodigious sensitiveness and there would be no Brownian motion to cause trouble.

### Necker's Map of Scotland

The first geological map of Scotland, made by Louis Albert Necker in the year 1808, was exhibited by Mr. V. A. Eyles, of the Geological Survey, at a meeting

of the Edinburgh Geological Society on March 9. The map, which belongs to the Geological Society of London, is based in part on information supplied to Necker by other geologists and in part on his own extensive travels in Scotland. The map has never been published, and in view of its historical importance, it is hoped to reproduce a colour facsimile. Mr. Eyles said that Necker, who was born in Switzerland, went to Edinburgh in 1806, and studied geology under Prof. Jameson at the University. He was a grandson of de Saussure, the famous Alpinist and geologist; he was related to Madame de Stael, the novelist, and to Necker, the financier, a minister of Louis XVI. After leaving Edinburgh in 1808, he became professor of mineralogy at Geneva, and travelled extensively in Europe. In 1821, he published an account of his travels in Scotland in a three-volume work entitled "Voyage en Ecosse et aux Iles hébrides". He returned to Edinburgh on several occasions. In 1841 he retired to Skye for reasons of health, and remained there until his death in 1861. He was buried at Portree.

### Comfort in Travel

AT the annual joint meeting of engineering and technical societies organized by the Institution of Automobile Engineers and held on March 10 at the Institution of Civil Engineers, three short papers were read on "Comfort in Travel". The first paper was on road travel by S. Garcke, the second on rail travel by Lord Stamp, and the third on air travel by Capt. E. W. Percival. Mr. Garcke pointed out that much of the improvement in the comfort in travel by road is due to the improvements of the surface of the roads. The invention of the railway was essentially the product of necessity, and was mainly due to finding something better than the water-bound flint or stone road. It seems improbable that further marked improvements in road surfaces can be anticipated. The discomfort due to nervous reaction imposed upon a driver by the presence on the road not only of many signals, but also of advertisements, lights and other contrivances, readily confused with official signs, is very real. Such signs are now greatly on the increase and will have to be controlled.

LORD STAMP laid stress on two elements in rail travel: mental ease and physical ease. Mental ease is promoted by removing difficulties in the way of finding out how to go and when to go. Throughout the United States and Canada many agencies have been established by the British railways, all with the object of easing matters for the customers. Physical ease is promoted by absence of disturbing vibration and noise and by the provision of adequate heating, ventilation and lighting. The L.M.S. Co. has employed eminent men of science in Great Britain to solve some of their problems, and both here and in the United States the motion of tyres of different profiles have been studied by means of cinematograph records. It has been found that a profile as nearly cylindrical as possible gives the greatest freedom from high-frequency lateral oscillations. Captain Percival considers that the development of the aeroplane has progressed more rapidly than that of any other form of transport vehicle. For very large cities it will soon be essential to have several main aerodromes so as to take care of the ever-increasing traffic.

### Social Survey of Bristol

A PRELIMINARY report on the standard of living in Bristol, by H. Tout, has been issued by the University of Bristol Social Survey, of which Mr. Tout is director ("The Standard of Living in Bristol: a Preliminary Report of the Work of the University of Bristol Social Survey." By Herbert Tout. Pp. 64. Bristol and London: J. W. Arrowsmith, Ltd., 1938. 1s. net). The comprehensive social survey of Bristol which is nearing completion has been made possible by the Colston Research Society, which has assumed entire financial responsibility, while the University undertook responsibility for the conduct of the research work and the appointment of the Survey staff. The preliminary report is only concerned with incomes which fall below middle-class levels, and covers four fifths of all Bristol families. The report indicates that, on the whole, the typical Bristol family is fortunately placed and probably better off than the families of many other towns. There are estimated to be 12,000 families in the Survey area which are very comfortable by the prevailing standards, which are not high, in the classes covered. At the other end of the scale there are 11,000 families in poverty. Between these extremes there are 56,000 families whose standard of living calls for no special remark, and some of these have a small margin for saving or pleasure. Beneath them come 21,000 families who, whilst not in poverty, have a hard struggle and whose lot is far from comfortable. Probably 40,000 people in the area live in actual poverty, and among them a disproportionate number of children, so that one out of five working-class children comes from a home that is unable to give it a fair start in life.

THE inquiry upon which the report is based was conducted from May to October 1937, coinciding roughly with the peak of the revival of business which started in 1932. The standard of minimum needs adopted in the survey in assessing poverty closely follows that used by Mr. R. F. George (*J. Roy. Statistical Soc.*, **100**, 74 (1); 1937). The average Bristol working-class family has a standard of living more than 100 per cent above its minimum needs, and the average size of the family is only slightly above that of the middle class (3·73 in the poorest groups as against 2·94 in the most comfortable group). The rate of poverty is highest for those under fifteen and lowest for those in their twenties, being only 4·1 per cent in the age group 20–24. Unemployment is outstandingly the most important reason for family income falling below 'needs', and affects nearly one third of the families. Old age ranks third in importance, rather less than one sixth of the cases being assigned to it. Broken families, in which there is no adult male earner, account for 10 per cent of

the cases and sickness for 9 per cent. Insufficient wages account for 21·3 per cent of all families below the standard.

### British Chemical Plant

THE reference in the leading article in NATURE of January 28 to the report of the Association of Scientific Workers, and more particularly to the urgent need for more State assistance for fundamental research, receives further emphasis from a recent discussion by the British Chemical Plant Manufacturers Association, following an earlier meeting in May 1938. In the report above-mentioned it was specifically indicated that among the more urgent and important cases where State support is required is that of chemical engineering, notably in connexion with raw materials and unit operations. Although the discussions of the B.C.P.M.A. were at first intended to be limited to the question of closer collaboration between chemical manufacturers, chemical plant manufacturers and consultants, with the view of quoting for and providing complete process units, it soon became evident that the scope of debate would have to be extended to include co-operation on much wider grounds, including not only fundamental scientific research but also the economic question of meeting foreign competition effectively. It was not easy to come to any definite decision or formulate a constructive policy of basic research: this is a matter for further discussion between the main sections of the chemical industry and the Government. When one considers, however, the strenuous and for the most part successful efforts of recent years to place chemical engineering in Great Britain on a sounder basis, it is to be hoped that the matter will not be left where it is, in view of its supreme importance in regard to national well-being, export trade and defence.

ON the question of more effectively meeting foreign competition, some plant manufacturers find that there appears to be a tendency both on the part of certain Government departments and of some of the chemical manufacturers to assume too readily and complacently that the British makers of chemical plant and apparatus are sometimes unable or unwilling to tender for complete process units, especially in connexion with new processes; and that this assumption has apparently formed the ground, or one of the grounds, for applications for licence to import foreign plant. The real truth, as was clearly shown at the last informal discussion of the British Chemical Plant Manufacturers Association, is that the need for these complete tenders from one firm is more infrequent than commonly supposed, and that, when it really does arise, the British manufacturer of plant is quite as well able as his foreign competitor to supply complete tenders if the inquiries are genuine and are accompanied by full details and complete designs. The allegation therefore that, whilst German or American firms will supply complete specifications and prices for the whole plant, it is necessary to apply to several different British firms for the various parts, with consequent greater delay, inconvenience, and enhanced cost, is not quite fair. Nevertheless the fact remains that much foreign plant has been and is still being imported. In addition to this discouragement, the British maker has to face ruthless Government-subsidized competition in foreign markets, and should therefore receive the greater support from his colleagues in the chemical industry and from the Government at home.

### Some Earthquakes Registered in 1937

WE have received from Dr. W. Hiller the data concerning earthquakes registered at Stuttgart, Ravensberg and Mesststetten-Ebingen in 1937. Stuttgart is now equipped with three Galitzin-Wilip seismographs orientated north-south, east-west, and vertical, one Wiechert vertical seismograph of mass 1,320 kgm., two Mainka seismographs of mass 450 kgm. set north-south and east-west, a seismograph of mass 80 kgm. orientated east-west and a horizontal Wiechert instrument of mass 17,000 kgm. Ravensberg has two Mainka pendulums of mass 450 kgm. orientated north-south and east-west, and two Conrad seismographs of 23 kgm. also set north-south and east-west. Messtetten-Ebingen is equipped with one vertical Wiechert instrument of mass 80 kgm., and two horizontal pendulums of mass 80 kgm. orientated north-south and east-west. The full list of constants for all these instruments is given. The main part of the report concerns the 426 earthquakes registered at these stations during 1937. For each shock recorded a full list of readings, including date, registering station, component, phase, arrival time, period, amplitude in $\mu$, and remarks chiefly concerning the epicentre and epicentral distance from the station, is given. Lastly, there follow two valuable additions to the compilation. First comes a tabulation of microseisms registered on the Galitzin-Wilip seismometers at Stuttgart, including the period and amplitude in $\mu$ on the three components, and secondly a careful study of the Hohenzollernalb earthquake of June 17, 1937. The epicentre of this is found to be 48° 15·3′ N., 9° 12·4′ E., ±2–3 km., depth of focus 19-20 km. ± about 4 km., and $T_0$ 9 h. 56 m. 41·8 s. ± 0·3 s. The publication forms a very valuable addition to the data and literature of seismology.

### 'Commercial' Water Culture of Plants

AN amusing example of the way in which the publicity of the Press may embarrass scientific workers is provided by the need for Circular 347 of the Agricultural Experiment Station, Berkeley, California, in which D. R. Hoagland and D. I. Arnon have to try to dispel illusions about the commercial possibilities of growing plants by water culture. The authors point out that the technique of water culture contains nothing new and has indeed been employed for more than a quarter of a century by this experiment station, whilst the method was, of course, described by the German physiologist Sachs in his text-book about 1860. The California Experiment Station must rue the day that Dr. W. F. Gericke conceived the idea that the method might have some

commercial application. A Sunday supplement article pictured a housewife opening a small closet off the kitchen and picking tomatoes from vines growing in water culture with the aid of electric lights, whilst a large chain of restaurants in New York City were credited with growing their own vegetables in basements. Actually, as the authors of this circular make clear, whilst very good yields may be obtained under glass from many crops grown in water cultures, with equal attention, similar or better crops may be grown in soil by methods which are more familiar to the amateur and professional grower.

### Foam on the Dead Sea

A PECULIAR phenomenon often to be seen on the northern waters of the Dead Sea is that of arcs of foam, more or less semicircular, spreading out fan-wise from certain points of the west and east shores. The arcs seem to spread from the shores in early morning and often meet and even cross during the forenoon. These lines of foam often bear reeds and other vegetation debris that have reached the Dead Sea by inflowing rivers, and, at the seasons of migration, the foam may attract flocks of birds searching for food. Dr. D. Ashbel has recorded some of his observations on this phenomenon and offers an explanation (*Geog. Rev.*, Jan. 1938). The arcs originate from springs on the two shores, and they make discontinuities between bodies of water of different salinity and density. When the outflow of the springs is strong, the arc is frequently not smooth but zig-zag. This explanation contradicts the earlier one of Blanckenhorn that the lines of foam originate from warm water arising along lines of fault on the sea floor. That suggestion does not explain lack of replacement of the lines as each moves forward, which Dr. Ashbel thinks is due to the gentle winds that frequently blow from the land on to the sea during the night and early morning. These winds do not ruffle the water and so mixing does not occur. Gusty west winds such as often occur in the afternoon cause mixing and so the lines of discontinuity disappear.

### The Imperial College of Tropical Agriculture

THE Imperial College of Tropical Agriculture in Trinidad is now the recognized centre for post-graduate training in tropical agriculture for the agricultural services of the Colonial Empire. The governing body in its latest report for the year ending August 31, 1938, record that 159 past students of the College have been appointed to the Colonial Agricultural Service and allied services, posts being now held in thirty different parts of the British Empire. The year under review was marked by the retirement of Sir Geoffrey Evans, who had filled the office of principal with much distinction since 1926, and who left the College with its function in the development of agriculture throughout the Colonial Empire firmly established, and with an international reputation as a centre of education and research. Mr. Odin Tom Faulkner, lately director of agriculture in the Straits Settlements and adviser on agriculture in the Malay States, was appointed to succeed Sir Geoffrey Evans. During 1937–38 the work of the College proceeded on normal lines. Research was mainly concerned with problems relating to cacao, sugar, bananas and citrus fruits, and the cost of much of the work was met by contributions from firms connected with the appropriate industry. The governing body is anxious to raise a substantial endowment fund; but its hope that the grant of £32,000 made by the Carnegie Corporation in 1932 towards this object would be followed by contributions from British firms and others interested in tropical agriculture has yet to be realized. Capital is also required for the purchase of more land for the college farm, for additional laboratories and the reconstruction of the biological building.

### The British Association: Engineering Section

AT the Dundee meeting of the British Association, 1939, the Engineering Section proposes to repeat the arrangement which proved so satisfactory during the meeting in Cambridge last year and to devote some time to the delivery of a number of short communications by junior engineers or research workers (under the age of thirty years). Each speaker will be allotted a total of 20–30 minutes, which may, at his option, include, say, ten minutes for very short discussion. It is hoped that each author will describe some item of special interest or novelty upon which he may be engaged. This innovation seems to us important as enabling the Association to know something of the work of younger men, and enabling those men to gain experience of summarizing their work and putting it forward for criticism without having to undertake the much more laborious task of preparing a paper of the stature necessary for a full meeting of one of the engineering institutions or of a scientific society. Although *Engineering* publishes *in extenso* the text of all main papers delivered to the Section, it is not proposed that these short papers should similarly be published. This arrangement seems desirable, partly because authors may be prepared to describe engineering work upon which they hope later to publish a full-scale paper, and partly because authors may not feel justified in preparing a text of the completeness which would be desirable if proper publication is to be made. Those wishing to submit such papers should communicate immediately with the recorder Wing-Commander T. R. Cave-Brown-Cave, University College, Southampton.

### *Spectrochimica Acta*

THE first number of a publication under the above title will shortly be issued by Messrs. Julius Springer, Berlin, under the editorship of W. Gerlach and G. Scheibe, Munich; A. Gatterer, Vatican Observatory; R. Breckpot, Louvain; F. Twyman, London. It will deal solely with spectrochemical analysis, and a useful feature will be the publication of abstracts and reviews of books and articles on the subject. A number of authorities on the subject have agreed to collaborate, and those in the English-speaking

countries who have already consented to act in that capacity include Prof. A. Fowler, Prof. H. Dingle and Dr. S. Judd Lewis of London; and Prof. O. S. Duffendack, Prof. J. A. Harrison and Dr. Lester W. Strock of the United States. The first number of the journal will probably be published in May. The English editor will be pleased to receive papers in English on the subject, which should be addressed to: The Editor, *Spectrochimica Acta*, 98 St. Pancras Way, London, N.W.1.

### University Co-operation

THE recently published report of the Executive Council of the Universities Bureau of the British Empire announces preliminary steps towards bringing about an informal conference between some of the heads of universities in the United States of America and those of universities in the British Empire. In the course of a trans-Atlantic tour undertaken last spring, primarily with the object of cultivating helpful relations with the Canadian universities, the secretary of the Bureau got into touch with the presidents of Harvard and Yale, the president of the Carnegie Corporation of New York and the director of the Institute of International Education, and discussed with them the possibility of a visit to England of some of the heads of universities in the United States in 1941, when the sixth quinquennial congress of the Universities of the British Empire will be held in Manchester.

### Announcements

THE Secretary of State for Air, Sir Kingsley Wood, on the recommendation of the Director of Medical Services, Royal Air Force, has appointed the following standing committee to investigate and advise him on the medical aspects of all matters concerning personnel which might affect safety and efficiency in flying: Sir Edward Mellanby (chairman), Prof. F. C. Bartlett, Mr. E. A. Carmichael, Mr. C. S. Hallpike, Dr. B. H. C. Matthews, Sir John Parsons and Prof. L. J. Witts. The representatives of the Air Ministry on the Committee will be Air Vice-Marshal A. V. J. Richardson, director of Medical Services, and Air Commodore H. E. Whittingham.

THE following have been elected officers of the Physical Society for the year ending March 1940: *President*, Prof. Allan Ferguson; *Vice-Presidents*, Prof. G. I. Finch, Dr. Ezer Griffiths, Dr. L. Hartshorn, Mr. R. W. Paul; *Hon. Secretaries*, Mr. J. H. Awbery, Dr. W. Jevons; *Hon. Foreign Secretary*, Prof. O. W. Richardson; *Hon. Treasurer*, Dr. C. C. Paterson; *Hon. Librarian*, Dr. J. H. Brinkworth.

THE following have been elected officers of the Geological Society of London for the ensuing year: *President*, Prof. H. H. Swinnerton; *Vice-Presidents*, Dr. E. B. Bailey, Prof. W. G. Fearnsides, Prof. O. T. Jones, and Prof. C. E. Tilley; *Secretaries*, Dr. L. Hawkes and Prof. W. B. R. King; *Foreign Secretary*, Sir Arthur Smith Woodward; *Treasurer*, Mr. F. N. Ashcroft.

THE following have been elected officers of the Quekett Microscopical Club for the ensuing year: *President*, W. E. Watson Baker; *Vice-Presidents*, H. G. Brown, C. H. Caffyn, D. J. Scourfield, P. K. Sartory; *Hon. Treasurer*, Dr. C. L. Odam; *Secretary*, Miss C. Arnold; *Reporter*, A. Morley Jones; *Curator*, C. J. Sidwell; *Assistant Curator*, W. F. Reeve; *Librarian*, H. C. G. Best; *Editor*, W. P. Sollis.

THE following appointments and promotions have recently been made in the Colonial Service: A. J. Hans, veterinary officer, Kenya; Dr. S. E. Piercy, veterinary research officer, Kenya; Dr. R. B. McConnell, assistant field geologist, Tanganyika Territory; P. A. Loizides, agricultural chemist, Cyprus; R. J. Lathbury, senior plant breeder, Agricultural Department, Kenya; R. G. H. Wilshaw, senior chemist (soils), Malayan Agricultural Service; H. G. Pudney, senior inspector of produce, Agricultural Department, Nigeria.

THE Leslie Dana Gold Medal awarded annually by the Association for Research in Ophthalmology and the St. Louis Society for the Blind was recently presented to Prof. Ellice M. Alger for his contributions to ophthalmology during the last thirty years and his work as a teacher. For many years he had been professor of clinical ophthalmology at the New York Postgraduate Medical School.

A CONFERENCE and working demonstration on "Pure Fruit Juices and Syrup" will be held at the Long Ashton Research Station of the Department of Agriculture and Horticulture, University of Bristol, on March 23. Further information can be obtained from the Director, Research Station, Long Ashton, near Bristol.

THE French Association for the Advancement of Science will meet this year at Liège on July 17–22, under the presidency of Prof. C. Fabry, director of the Optical Institute, Paris. The local committee for the meeting is under the chairmanship of Prof. Dehalu, of the University of Liège.

A FLEMISH Academy of Medicine, consisting of six sections, has recently been founded at Brussels.

THE fifth International Congress for First Aid will be held at Zurich and St. Moritz on July 23–28.

THE eighteenth Congress of the German Association for Microbiology will be held in Vienna on March 27–30. Further information can be obtained from the Secretary, Prof. Wohlfeil, Führerstrasse 2, Berlin, N.15.

REPRESENTATIVES of thirty-five countries will attend the tenth International Congress of Military Medicine and Pharmacy, which is to be held at Washington on May 7–15. Further information can be obtained from the Secretary-General of the Congress, Army Medical Library, Washington, D.C.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

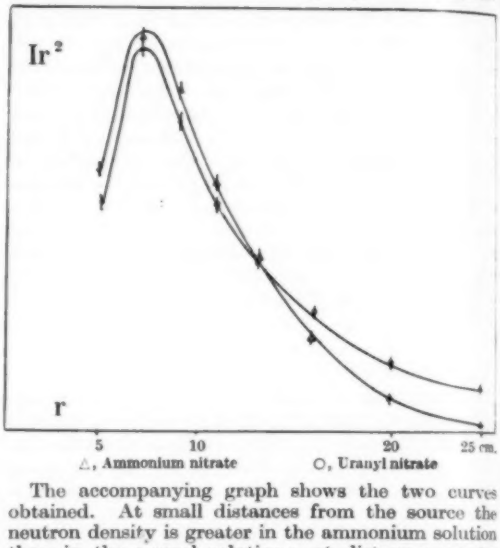
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 478.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Liberation of Neutrons in the Nuclear Explosion of Uranium

RECENT experiments[1,2] have revealed the existence of a new kind of nuclear reaction: neutron bombardment of uranium and thorium leads to an explosion of the nucleus, which splits up into particles of inferior charge and weight, a considerable amount of energy being liberated in this process. Assuming a partition into two particles only, so that the nuclear mass and charge of uranium have to be distributed between two lighter nuclei, the latter contain considerably more neutrons than the heaviest stable isotopes with the same nuclear charges. (A splitting into, for example, $^{98}$Rb and $^{141}$Cs means an excess of 11 neutrons in the first, and of 8 neutrons in the second of these two nuclei.) There seem to be two possibilities of getting rid of this neutron excess. By the emission of a β-ray, a neutron is transformed into a proton, thus reducing the neutron excess by two units; in the example given above, five and four successive β-activities respectively would be needed to restore the neutron-proton stability ratio. In fact, the explosion products have been observed to be β-active and several periods have been recorded, so that a part, at least, of the neutron excess is certainly disposed of in this way. Another possible process is the direct liberation of neutrons, taking place either as a part of the explosion itself, or as an 'evaporation' from the resulting nuclei which would be formed in an excited state.

In order to find some evidence of this second phenomenon, we studied the density distribution of the thermal neutrons produced by the slowing down of photo-neutrons from a Ra γ - Be source in a 1·6 molar solution of uranyl nitrate and in a 1·6 molar solution of ammonium nitrate (the hydrogen contents of these two solutions differ by only 2 per cent). Plotting $Ir^2$ as a function of $r$ (where $r$ is the distance between the source and a given point, and $I$ is the local density of thermal neutrons at the same point, measured by the activity induced in a dysprosium detector), a curve is obtained the area of which is proportional to $Q.\tau$, $Q$ being the number of neutrons per second emitted by the source or formed in the solution and $\tau$ the mean time a neutron spends in the solution before being captured[3,4]. Any additional nuclei, which do not produce neutrons, brought into the solution, will increase the chances of capture and therefore decrease $\tau$ and the area. If, however, these dissolved nuclei are neutron-producing, $Q$ will be greater and the area of the curve will tend to increase. Evidence of neutron production, as indicated by an actual increase of the area, will only be obtained if the gain through $Q$ (neutron production) is greater than the loss through $\tau$ (neutron capture). This loss can anyway be studied separately, since it has been shown[5] that the introduction of nuclei which act merely by capture or by increasing the hydrogen content of the solution can affect the shape of the density curve only in a characteristic way: the modified curve can always be brought to coincide with the primitive curve by multiplying all abscissæ by a suitable factor and all ordinates by another factor.




The accompanying graph shows the two curves obtained. At small distances from the source the neutron density is greater in the ammonium solution than in the uranyl solution; at distances greater than 13 cm., the reverse is true. In other words, the decrease of the neutron density with the distance is appreciably slower in the uranyl solution.

The observed difference must be ascribed to the presence of uranium. Since the two curves cannot be brought to coincide by the transformation mentioned above, the uranium nuclei do not act by capture only; an *elastic* diffusion by uranium nuclei would have an opposite effect: it would 'contract' the abscissæ, instead of stretching them. The density excess, shown by the uranyl curve beyond 13 cm., must therefore be considered as a proof of neutron production due to an interaction between the primary neutrons and the uranium nuclei. A reaction of the well-known $(n,2n)$ type is excluded because our primary neutrons are too slow for such a reaction (90 per cent of Ra + Be photo-neutrons have energies smaller than 0·5 Mev. and the remaining 10 per cent are slower than 1 Mev.).

The degree of precision of the experiment does not permit us to attribute any significance to the small increase of the area in the uranyl curve (as compared to the ammonium curve), which we obtain by extrapolating the curves towards greater distances. In any event, an inferior limit for the cross-section for the production of a neutron can be obtained by

assuming that the density excess due to this production is equal throughout the whole curve to the excess observed at $r = 25$ cm.; this limit, certainly inferior to the actual value, is $6 \times 10^{-25}$ cm.$^2$.

Our measurements yield no information on the energy of the neutrons produced. If, among these neutrons, some possess an energy superior to 2 Mev., one might hope to detect them by a $(n,p)$ process, for example, by the $^{32}S(n,p)^{32}P$ reaction. An experiment of this kind, Ra $\gamma$ - Be still being used as the primary neutron source, is under way.

The interest of the phenomenon observed as a step towards the production of exo-energetic transmutation chains is evident. However, in order to establish such a chain, more than one neutron must be produced for each neutron absorbed. This seems to be the case, since the cross-section for the liberation of a neutron seems to be greater than the cross-section for the production of an explosion. Experiments with solutions of varying concentration will give information on this question.

H. VON HALBAN, JUN.
F. JOLIOT.
L. KOWARSKI.

Laboratoire de Chimie Nucléaire,
Collège de France,
Paris.
March 8.

[1] Joliot, F., *C.R.*, **208**, 341 (1939).
[2] Frisch, O. R., NATURE, **143**, 276 (1939).
[3] Amaldi, E., and Fermi, E., *Phys. Rev.* **50**, 899 (1936).
[4] Amaldi, E., Hafstad, L., and Tuve, M., *Phys. Rev.*, **51**, 896 (1937).
[5] Frisch, O. R., von Halban, jun., H., and Koch, J., *Danske Videnskab. Kab.*, **15**, 10 (1938).

## Products of the Fission of the Uranium Nucleus

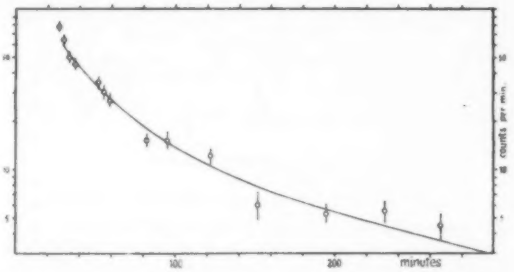
O. Hahn and F. Strassmann[1] have discovered a new type of nuclear reaction, the splitting into two smaller nuclei of the nuclei of uranium and thorium under neutron bombardment. Thus they demonstrated the production of nuclei of barium, lanthanum, strontium, yttrium, and, more recently, of xenon and cæsium.

It can be shown by simple considerations that this type of nuclear reaction may be described in an essentially classical way like the fission of a liquid drop, and that the fission products must fly apart with kinetic energies of the order of hundred million electron-volts each[2]. Evidence for these high energies was first given by O. R. Frisch[2] and almost simultaneously by a number of other investigators[4].

The possibility of making use of these high energies in order to collect the fission products in the same way as one collects the active deposit from alpha-recoil has been pointed out by L. Meitner (see ref. 3). In the meantime, F. Joliot has independently made experiments of this type[5]. We have now carried out some experiments, using the recently completed high-tension equipment of the Institute of Theoretical Physics, Copenhagen.

A thin layer of uranium hydroxide, placed at a distance of 1 mm. from a collecting surface, was exposed to neutron bombardment. The neutrons were produced by bombarding lithium or beryllium targets with deuterons of energies up to 800 kilovolts. In the first experiments, a piece of paper was used as a collecting surface (after making sure that the paper did not get active by itself under neutron bombardment). About two minutes after interrupting the irradiation, the paper was placed near a Geiger-Müller counter with aluminium walls of 0·1 mm. thickness. We found a well-measurable activity which decayed first quickly (about two minutes half-value period) and then more slowly. No attempt was made to analyse the slow decay in view of the large number of periods to be expected.

The considerable intensity, however, of the collected activity encouraged us to try to get further information by chemical separations. The simplest experiment was to apply the chemical methods which have been developed in order to separate the 'transuranium' elements from uranium and elements immediately below it[6]. The methods had to be slightly modified on account of the absence of uranium in our samples and in view of the light element activities discovered by Hahn and Strassmann[1].




In these experiments, the collecting surface was water, contained in a shallow trough of paraffin wax. After irradiation (of about one hour) a small sample of the water was evaporated on a piece of aluminium foil; its activity was found to decay to zero. It was checked in other ways, too, that the water was not contaminated by uranium. To the rest of the water we added 150 mgm. barium chloride, 15 mgm. lanthanum nitrate, 15 mgm. platinum chloride and enough hydrochloric acid to get an acid concentration of 7 per cent. Then the platinum was precipitated with hydrogen sulphide, in the usual way; the precipitate was carefully rinsed and dried and then placed near our counter.

The results of three such experiments were found to be in mutual agreement. The decay of the activity was in one case followed for 28 hours. For comparison, a sample of uranium irradiated for one hour was treated chemically in the same way. The two decay curves were in perfect agreement with one another and with an old curve obtained by Hahn, Meitner and Strassmann under the same conditions. In the accompanying diagram the circles represent our recoil experiment while the full line represents the uranium precipitate. A comparison of the activity (within the first hour after irradiation) of the precipitate and of the evaporated sample showed that the precipitate contained about two thirds of the total activity collected in the water. After about two hours, however, the evaporated sample was found to decay considerably more slowly than the precipitate, presumably on account of the more long-lived fission products found by Hahn and Strassmann[1].

From these results, it can be concluded that the 'transuranium' nuclei originate by fission of the uranium nucleus. Mere capture of a neutron would give so little kinetic energy to the nucleus that only a vanishing fraction of these nuclei could reach the water surface. So it appears that the 'transuranium'

periods, too, will have to be ascribed to elements considerably lighter than uranium.

In conclusion, we wish to thank Dr. T. Bjerge, Dr. J. Koch and K. J. Brostrøm for putting the high-tension plant at our disposal and for kind help with the irradiations. We are also grateful to Prof. N. Bohr for the hospitality extended to us at the Institute of Theoretical Physics, Copenhagen.

LISE MEITNER.

Physical Institute,
Academy of Sciences,
Stockholm.

O. R. FRISCH.

Institute of Theoretical Physics,
University,
Copenhagen.
March 6.

[1] Hahn, O., and Strassmann, F., *Naturwiss.*, **27**, 11, 89, and 163 (1939).
[2] Meitner, L., and Frisch, O. R., NATURE, **143**, 239 (1939). Bohr, N., NATURE, **143**, 330 (1939).
[3] Frisch, O. R., NATURE, **143**, 276 (1939).
[4] Fowler, R. D., and Dodson, R. W., NATURE, **143**, 233 (1939). Jentschke, W., and Prankl, F., *Naturwiss.*, **27**, 134 (1939).
[5] Joliot, F., *C. R.*, **208**, 341 (1939).
[6] Hahn, O., Meitner, L., and Strassmann, F., *Chem. Ber.*, **69**, 905 (1936); and **70**, 1374 (1937).

## Radioactive Organic Bromo-Compounds

CONSIDERABLE attention has recently been focused on the use of artificially radioactive substances in biological work. The radioactive isotope $^{82}Br$ has been chosen by us because it has a conveniently long half-life (34 hours), it is chemically reactive, it gives off gamma-rays which aid in its detection, and finally, it can be prepared from $^{81}Br$ either by the action of slow neutrons or deuterons. Slow neutrons are easily available from the radon-beryllium reaction. Fast deuterons from the cyclotron or any other suitable high-energy source may be used either as projectiles themselves or for the production of slow neutrons as in the lithium reaction below. The relative abundance of $^{81}Br$ in natural bromine is 49·3 per cent. Contamination of radioactive $^{82}Br$ by other isotopes is of no consequence since bromine forms no non-bromine radioactive elements on bombardment by slow neutrons or deuterons[1].

Two reactions have been studied. The first is the Sandmeyer reaction for the introduction of bromine into the benzene ring. 345 c.c. of water containing 50 gm. $Cu_2Br_2$, 175 gm. $NaBr.2H_2O$ and 30 c.c. HBr (density 1·49) was bombarded by slow neutrons produced from lithium with 900 kev. deuterons. 250 gm. of $CHBr_3$ was also bombarded. The glass vessels were surrounded by thick blocks of paraffin. Two experiments were then performed. 115 c.c. of the solution called the Sandmeyer solution was shaken with the whole of the bombarded $CHBr_3$ to concentrate the radioactivity[2], then separated off and extracted with $CHCl_3$. 14·5 gm. of $C_6H_5NH_2$ was diazotized in the usual manner and 11·8 gm. of $C_6H_5Br$ prepared, called $C_6H_5Br$ (1). Another sample, called $C_6H_5Br$ (2), was made from a second 115 c.c. of the Sandmeyer solution, not shaken with the $CHBr_3$. As expected, attempts to exchange the radioactive bromine in $C_6H_5Br$ by shaking with NaBr were wholly unsuccessful.

Table 1 shows the radioactivity per gram atom of bromine compared to that of the Sandmeyer solution before concentration of the radioactivity. Measurements were made with a thin-walled Geiger-Müller counter. The samples were in glass vessels and the measurements were made nearly simultaneously to obviate corrections due to radioactive decay. It is to be emphasized that, although care was taken to keep the geometry constant, the results can only be taken as qualitative.

TABLE 1

| | Relative radioactivity per gram atom Br. |
|---|---|
| Sandmeyer solution | 1·0 |
| $CHBr_3$ before enrichment of Sandmeyer solution | 2·6 |
| $CHBr_3$ after enrichment | 1·4 |
| $C_6H_5Br$ (1) | 4·2 |
| $C_6H_5Br$ (2) | 0·6 |
| $C_6H_5Br$ (1) after shaking with NaBr | 4·2 |

The second technique is the addition of bromine to a double bond. 100 gm. $CH_2Br_2$ was irradiated with slow neutrons and after irradiation 0·2 c.c. of bromine was added. Three hours later 1·2 gm. of cholesterol in 12 c.c. of ether was added, and the $CH_2Br_2$ distilled off in vacuum. The crystalline residue was dissolved in ether and recrystallized. Table 2 shows the relative radioactivity per gram atom of bromine compared with the irradiated $CH_2Br_2$. Experiments with $CHBr_3$ in place of the $CH_2Br_2$ yielded an oil from which the cholesterol dibromide could not be separated.

TABLE 2

| | Relative radioactivity per gram atom Br. |
|---|---|
| $CH_2Br_2$ before enrichment | 1·0 |
| $CH_2Br_2$ after enrichment | 0·5 |
| Cholesterol dibromide | 300 |

The first method does not yield such a high concentration of radioactive material. It may be of use in the labelling of halogenated molecules and the determination of their fate in the body. The second technique gives a very high concentration of radioactivity. It is hoped to obtain concentrations high enough to enable us to study the effect of artificial radioactivity on normal and pathological tissues. Further work will be done along these lines.

We wish to express our thanks to the members of the Cavendish High Tension Laboratories for help in the slow neutron bombardments.

E. FRIEDMANN.
(Biochemical Laboratory)
A. K. SOLOMON
(Cavendish Laboratory)
N. T. WERTHESSEN.
(School of Agriculture)

Cambridge.
Feb. 14.

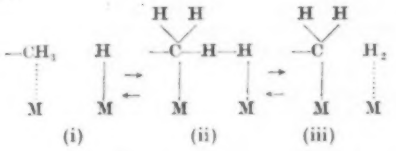
[1] Snell, *Phys. Rev.*, **52**, 1007 (1937).
[2] Szillard and Chalmers, NATURE, **134**, 462 (1934).

## Catalytic Exchange of Deuterium and Hydrogen in Hydrocarbons

IN a recent communication[1], L. and A. Farkas have followed the exchange of deuterium for hydrogen in cyclohexane and hexane on platinized foil at relatively low temperatures. They suggest that the catalytic mechanism for both saturated and unsaturated hydrocarbons involves the primary detachment of a hydrogen atom from the hydrocarbon. We have had occasion to examine the mechanism of catalytic exchange with olefines by a number of different methods, and have come to the definite conclusion that the primary act in the case of olefines is the addition and not the loss of a hydrogen atom.

This conclusion is supported by experiments on the effect of hydrogen both on double bond migration and on ring closure in olefines.

Further, in the case of saturated hydrocarbons, catalytic exchange, degradation and dehydrogenation all appear to involve hydrogen in the chemisorption process, but the experimental data are not as yet so conclusive as is the case for the olefines. If further experiments support this point of view, it might be suggested that the simplest representation of the hydrocarbon catalyst hydrogen system is as follows:




where (i) chemisorbed hydrogen reacts with a Van der Waals adsorbed saturated hydrocarbon group, or (iii) a chemisorbed olefine reacts with a Van der Waals adsorbed molecule of hydrogen each producing the common transition complex, (ii).

This simple formulation offers a ready interpretation of the various reactions observed in these systems. It is hoped that opportunity will present itself in the forthcoming meeting of the Faraday Society for an adequate discussion on the elementary steps operative in hydrocarbon catalytic reactions, reactions of far-reaching importance, and on the nature of which there is clearly as yet no unanimity.

S. R. CRAXFORD.
G. H. TWIGG.
ERIC K. RIDEAL.

Laboratory of Colloid Science,
Cambridge.

[1] NATURE, **143**, 244 (1939).

## Chemical Aspects of the Cyclol Hypothesis

CONSIDERABLE discussion of the structure of proteins, especially in relation to the cyclol hypothesis, has recently appeared in NATURE[1,2,3]. This theory assumes that globular proteins consist of a space-enclosing arrangement of diazine and triazine rings. Most of the evidence produced (including the X-ray diagrams[2,3]) is, however, not specific for the cyclol theory; many of the points made by Langmuir[4] could be equally well used as an argument in favour of any regular geometrical structure which joins peptide chains to form a globular molecule. It is indeed possible to suggest bonds between peptide chains of types already known to exist; thus we are familiar with compounds containing the linkages S—S, CO—S, NH—S or CO—NH—CO, all of which might occur in proteins; in addition, the possibility exists of linkages between hydroxyl groups of hydroxy-amino acids and free carboxyl groups.

The more specific points of evidence in support of the cyclol theory are: (*a*) it claims to predict molecular weights of the order of magnitude found with the ultracentrifuge; (*b*) it conforms with the regularities in the amino acid composition of proteins (Bergmann and Niemann); (*c*) it gives a reasonable picture of denaturation as 'decyclization' or change from cyclol to chain structure.

(*a*) Wrinch assumes that egg albumin contains 288 residues; on the other hand, Svedberg[5] finds a molecular weight of 40,500 or 43,800, which would lead to average residue weights of 159 and 170 respectively. Since it is known that egg albumin does not consist mainly of 'heavy' amino acids, such as tyrosine, tryptophane or arginine, the value of 288 cannot be accepted for the number of residues in egg-albumin.

(*b*) The regularities in amino acid composition deduced by Bergmann and Niemann are based on analytical results which are not sufficiently accurate to be statistically significant[6].

(*c*) If denaturation consists of decyclization, it should occur in all globular proteins having a cyclol structure and not in fibrous proteins. Actually, insulin, a globular protein which has been extensively studied in connexion with the cyclol theory, cannot be denatured in the usual sense of the word; it is very resistant towards heat or acid, and it can even be recovered in crystalline form after esterification with acid alcohol followed by treatment with dilute alkali[7]. On the other hand, a fibrous protein, like myosin, for which no cyclol structure can be claimed, denatures easily at temperatures above 40°.

Further, it seems difficult to reconcile the reversibility of denaturation[8,9] found for serum albumin with the supposed instability of cyclol rings. Another difficulty is that low-molecular peptides or diketopiperazines would be expected to be found when the cyclol structure breaks down. Actually, no such low-molecular compounds are liberated on denaturation. It follows, therefore, that the cyclol theory cannot satisfactorily explain the facts of denaturation.

To explain the behaviour of proteins towards enzymes, Langmuir and Wrinch[1] assume that denaturation occurs before the enzyme can attack the protein molecule. This may be the case for many proteins; but insulin is hydrolysed by pepsin or trypsin under conditions in which the insulin molecule is perfectly stable. Here enzymic hydrolysis must take place without previous denaturation. In order to explain these facts, the unwarranted assumption would have to be made that the enzyme not only hydrolyses the protein, but also decyclizes it.

Attempts to prove the cyclol structure in proteins have failed so far (see, for example, Haurowitz[10]), nor has it been possible to synthesize simple models of the cyclol type in the laboratory; the physical evidence for the hypothesis is most uncertain[2,3] and the lactam-lactim tautomerism of peptides, which is the chemical basis of the cyclol theory, has never been demonstrated by either physical or chemical methods. Is it surprising, therefore, that chemists are reluctant to accept a structure for which no analogue in organic chemistry can be found?

A. NEUBERGER.

University College Hospital Medical School,
University Street, Gower Street,
London, W.C.1.

[1] Langmuir and Wrinch, NATURE, **143**, 49 (1939).
[2] Bernal, NATURE, **143**, 74 (1939).
[3] Bragg, NATURE, **143**, 73 (1939).
[4] Langmuir, Address to the Physical Society, Dec. 20, 1938, NATURE, **143**, 34 (1939).
[5] Svedberg, NATURE, **139**, 1051 (1937).
[6] Neuberger, Royal Society Discussion on Proteins, Nov. 17, 1938, NATURE, **142**, 1024 (1938).
[7] Charles and Scott, *J. Biol. Chem.*, **92**, 289 (1931).
[8] Anson and Mirsky, *J. Gen. Physiol.*, **14**, 725 (1931).
[9] Miller, *J. Exp. Med.*, **58**, 625 (1933).
[10] Haurowitz, *Hoppe-Seyl. Z.*, **256**, 28 (1938).

[See also p. 482 of this issue.]

## Chromatographic Fractionation of Whale-Liver Oil

Pritchard, Wilkinson, Edisbury and Morton[1] have already reported striking disagreement between the biological activity and the absorption at 328 mμ of the concentrates of mammalian liver. As we had formerly used the Carr-Price reaction to a great extent for practical determinations, we were interested in its relation to ultra-violet absorption and to biological activity. We therefore fractionated whale-liver oil and determined the blue colour with trichloride of antimony, the curve for the ultra-violet absorption, and the biological activity, of the various fractions thus obtained.

The fractionation was carried out in the following way: The oil was first saponified, after which the part that could not be saponified was given further treatment. (We offer our best thanks to Messrs. Ferrosan and Co., Ltd., Copenhagen, for so kindly supplying a large quantity of the unsaponifiable part of whale-liver oil.) The sterols were eliminated by crystallization from methyl alcohol, first in an ice-box, and then by freezing in solid carbon dioxide and acetone. The soluble part was dissolved in petroleum-ether and submitted to chromatographic separation with calcium hydroxide as an adsorbent. Painting with antimony trichloride, as described by Zechmeister, Cholnoky and Ujhélyi[2], gave a positive reaction for the whole length of the column, and the adsorption column was, therefore, divided arbitrarily into four parts, from which vitamin A was eluted by petroleum-ether containing a little methyl alcohol. The top fraction gave a red-violet reaction towards antimony trichloride, which, according to our standard curve, would have meant about 101,000 I.U. per gm. activity of vitamin A. Biological assay, however, showed that it was quite inert. The next fraction should have contained 3,160,000 I.U. per gm., according to the antimony trichloride reaction, but the biological activity was 1,160,000 I.U. per gm. It has been impossible, unfortunately, up to the present to evaluate the ultra-violet absorption on account of lack of material. All three determinations are, however, available for the third and fourth fractions:

| | III | IV |
|---|---|---|
| Biological activity .. .. | 531,000 I.U./gm. | 562,000 I.U./gm. |
| Antimony trichloride value .. | 950,000 „ | 1,160,000 „ |
| Ultra-violet absorption at 328 mμ .. .. .. | 384,000 | 382,000 „ |

The biological activity is thus considerably lower than would have been expected from the antimony trichloride reaction. The biological activity is greater than might have been expected from the ultra-violet absorption, but not so much, when the number of animals used for the biological assay is taken into consideration. The absorption maxima for the ultra-violet curve are not, however, at 328 mμ, but are displaced towards the short-wave part—more exactly, at 293 mμ.

The investigations of Gillam, Heilbron, Jones and Lederer[3] showed that there is a substance in the liver of freshwater fish with vitamin A activity, the absorption maximum of which is at 344 mμ. This substance does not occur alone, but together with the ordinary vitamin A. It has, however, not been possible to produce the actual substance in pure form, though the English investigators were able to determine the chemical constitution of the new substance by preparing suitable derivatives.

According to our experiments, whale-liver oil does not contain this substance. The ultra-violet absorption at wave-lengths longer than 328 mμ is weak even for our chromatographic fractions, and we cannot find a maximum for the antimony trichloride reaction at 690 mμ. On the other hand, the maxima for the ultra-violet absorption of our fractions III and IV agree well with the results given by Pritchard, *et al.*

It has already been shown many times that the maximum absorption occurs at 570–580 mμ for the antimony trichloride reaction of vitamin A. Chromogen 610 and chromogen 570 were separated by adsorption on to fuller's earth[4] in Wolff's laboratory. Karrer, Morf and Schöpp[5] isolated the so-called hepaxanthin, the absorption maximum of which is at 270 mμ. Hepaxanthin is not thought to have any biological activity.

Since our highly purified products, however, show greater absorption for the antimony trichloride reaction at 570 mμ than at 610 mμ, have a distinct maximum in the ultra-violet field at about 290 mμ, and possess biological activity which, as has been mentioned, is considerably greater than that corresponding to the absorption at 328 mμ, it does not seem to be impossible that our preparations contain a hitherto unknown substance with the biological action of vitamin A.

HARRY WILLSTAEDT.
HANS BEHRNTS JENSEN.

University Institute of Hygiene,
Copenhagen,
and
The State Vitamin Laboratory,
Copenhagen.
Feb. 6.

[1] Pritchard, H., Wilkinson, H., Edisbury, J. R., and Morton, R.A., *Biochem. J.*, **31**, 258 (1937).
[2] Zechmeister, L., v. Cholnoky, L., and Ujhélyi, E., *Bull. Soc. chim. biol.*, **18**, 1885 (1936).
[3] Gillam, A. E., Heilbron, I. M., Jones, W. E., and Lederer, E., *Biochem. J.*, **32**, 405 (1938).
[4] van Eekelen, M., Emmerie, A., Julius, B., and Wolff, K. L., *Proc. Kon. Akad. van Wetenschappen Amsterdam*, **35**, 1347 (1932).
[5] Karrer, P., Morf, R., and Schöpp, K., *Helv. chim. Acta*, **16**, 631 (1933).

---

## Formation of Negative Ions by Negative-Ion Bombardment of Surfaces: a New Process

EXPERIMENTS with a double mass-spectrograph have been described recently by one of us and R. Press[1]. These show conclusively that bombardment of a gas-contaminated surface with positive ions of one species can produce a spectrum of negative ions. In this work particular attention was directed to the process involved. We have now extended these experiments, in the first place, to identify some light ions, the identity of which was not definitely established in the earlier work. By calibrating the mass-spectrograph with a Kunsman alkali ion source, used in such a way that the magnet current did not have to be altered from the value used during the negative ion runs, we have identified accurately the main negative ion peaks, with results in general accord with the early work of Woodcock[2] (which we had previously overlooked), and with that of Arnot and Beckett[3].

We have also studied the emission of negative ions from oxide-coated cathodes, which can be liberated either by heating[4] or by positive ion bombardment[5]. During an investigation of the energy distributions of these ions, an interesting effect was observed. A wire gauze had been inserted between the cathode

and the first slit of the mass-spectrograph to permit of the electric field at the cathode being held constant, while the energy of the ions entering the first slit was varied. A diffuse negative ion peak in the region of mass numbers 24–26 was found to be multiple, with some of the ions showing energies in excess of those imparted to them by the accelerating electric fields. When the potential difference between the gauze and cathode was increased, the two main components separated, but one remained in the original position in the mass spectrum ($M = 26$). This shows that it was due to ions from the cathode, while the other was due to ions from the gauze. If the latter had been produced by positive ion bombardment of the gauze, then one would expect the cathode and its supports to have been similarly bombarded and negative ions to have been liberated from them with large initial energies. However, investigation of the energy distribution of the ions liberated from the cathode revealed that no ions were present with initial energies, so indicating the absence of any appreciable positive ion bombardment of this electrode, since such bombardment is known to liberate ions with initial energies[1]. In the absence of positive ion bombardment, we are forced to the conclusion that the negative ions from the gauze are emitted as a result of bombardment of the latter by negative ions from the cathode. The ions so emitted, like those produced by positive ion bombardment, show excess energies.

The peak from the gauze in the region $M = 26$ is complex, and is found when examined under sufficient resolution to consist of three peaks due to ions of masses 24, 25 and 26, possibly $C_2^-$, $C_2H^-$ and $CN^-$. $Cl_{35}^-$ and $Cl_{37}^-$ have also been detected from the cathode, but not from the gauze under the same conditions.

This new process seems to account for an effect observed by Bachman and Carnahan[5], who have published photographs of the negative ion spectrum which they were able to produce on the screen of a cathode ray oscillograph. In one case, when an oxide-coated cathode was broken down after the tube was sealed off from the pumps, they recorded a circle surrounding the spot due to the ion of mass 26. Since this tube was slightly soft, due to liberation of gas during the activation of the cathode, it is possible that the ring was produced by positive ion bombardment of one of the apertures in the vicinity of the cathode. However, in the case of a hard tube containing a hairpin tungsten filament, they obtained several circles in the spectrum. It is almost certain that these are due in part to bombardment of an aperture by negative ions from the filament. Unfortunately, Bachman and Carnahan do not give details of their focusing fields, so that a quantitative check is not possible.

A similar negative ion emission is to be expected from some of the grids of commercial multi-electrode thermionic valves with oxide-coated cathodes.

R. H. SLOANE.
ELIZA B. CATHCART.

Department of Physics,
Queen's University,
Belfast.
Feb. 15.

[1] Sloane, R. H., and Press, B., NATURE, 141, 872 (1938); *Proc. Roy. Soc.*, A, 168, 284 (1938).
[2] Woodcock, K. S., *Phys. Rev.*, 38, 1696 (1931).
[3] Arnot, F. L., and Beckett, C., *Proc. Roy. Soc.*, A, 168, 103 (1938).
[4] Barton, H. A., *Phys. Rev.*, 26, 360 (1925).
[5] Bachman, C. M., and Carnahan, C. W., *Proc. I.R.E.*, 26, 529 (1938).

## Oxidation of Reduced Codehydrogenase I

THE discovery of an enzyme[1,2] capable of catalysing the oxidation of reduced codehydrogenase I (cozymase, CoI) at an extremely rapid rate[3] naturally raises the question as to what part this enzyme plays in hydrogen transport. There is considerable evidence[1,3,4,5] that this enzyme (diaphorase) catalyzes the reaction between dihydrocozymase and the cytochrome system, and Dewan and Green[3] have suggested that cytochromes *A* and *B* (but not *C*) and cytochrome oxidase are involved. The method of preparing diaphorase is such that succinic acid dehydrogenase is also present in large amounts. With the possible exception of the recent announcement[3] that diaphorase had been obtained in highly purified form, it seems fairly certain that most of the data in the literature regarding either enzyme were obtained with preparations containing both enzymes. This statement has a very important bearing on the 4-carbon acid catalysis theory of Szent-Györgyi, since it raises the question as to the possibility that succinic acid dehydrogenase is an intermediary hydrogen carrier between diaphorase and cytochrome.

The present work was begun with the purpose of finding the path by which hydrogen proceeds from dihydrocozymase over diaphorase to molecular genoxy. The succinic acid dehydrogenase preparation of Stotz and Hastings[6] was used as a source of diaphorase. This preparation is an alkaline phosphate extract of washed pig heart muscle, with fumarase inactivated (enzyme *A*). This enzyme is in the form of a dispersion which does not settle out. It was shown to contain diaphorase, succindehydrogenase, cytochrome, and cytochrome oxidase, and small amounts of triose phosphate dehydrogenase. In addition, a dialysed extract of acetone powder from rabbit skeletal muscle[7] (enzyme *B*) was used as a source of triose phosphate dehydrogenase and zymohexase. Considerable work was done with dry preparations but in these there was no reaction between $CoH_2I$ and oxygen until dye was added.

The reactions involved in this work may be written as follows:

$$\text{hexosediphosphate} \rightarrow 2 \text{ triose phosphate} \quad (1)$$

$$\text{triose phosphate} + \text{CoI} \rightarrow \text{phosphoglyceric acid} + CoH_2I \quad (2)$$

$$\text{phosphoglyceric acid} \rightarrow H_3PO_4 + \text{pyruvic acid} \quad (3)$$

$$CoH_2I + 1/2\ O_2 \rightarrow \text{CoI} + H_2O \quad (4)$$

$$\text{succinic acid} + 1/2\ O_2 \rightarrow \text{fumaric acid} + H_2O \quad (5)$$

By using an excess of enzyme *B*, cozymase, and hexose diphosphate in the presence of fluoride, and determining the amount of enzyme *A* which limited oxygen uptake, it was possible to study reaction (4) using amounts of enzyme *A* which gave approximately half maximum rates of oxygen uptake. Parallel experiments were always run with an equal amount of enzyme *A* using succinic acid as substrate. This demonstrated the presence of succindehydrogenase and the cytochrome system.

It was found that fresh preparations of enzyme *A* were capable of bringing about reactions (4) and (5) at an extremely rapid rate; but that after about five days at 4° C. the activity was nearly completely destroyed. Crucial experiments were therefore performed at various times after the enzyme was prepared. Since neither the diaphorase nor the succindehydrogenase were appreciably destroyed in this period, it appears that the destruction occurs in the cytochrome oxidase or possibly in cytochrome *B*

This point is being studied further. The fact that the rate of reaction (4) appears to decrease faster than the rate of reaction (5) suggests that different cytochromes may be involved.

EFFECT OF STANDING ON THE ENZYME SYSTEMS WHICH OXIDIZE $CoH_2I$ AND SUCCINIC ACID. 0·2 C.C. OF ENZYME *A* IN ALL CASES. HEXOSE DIPHOSPHATE SUBSTRATE FOR $CoH_2I$ OXIDATION.

| Expt. No. | Hours since preparation | $CoH_2I$ oxidation | | Succinate oxidation 0–30 min. |
|---|---|---|---|---|
| | | 0–30 min. no dye | 30–60 min. + brilliant cresyl blue | |
| | | cub. mm. $O_2$ | cub. mm. $O_2$ | cub. mm. $O_2$ |
| 14 I*A* | 24 | 205 | 63 | 182 |
| 14 II*A* | 30 | 197 | 65 | 176 |
| 14 II*B* | 48 | 195 | — | 168 |
| 14 II*C* | 90 | 40 | 72 | 70 (+ cytochrome, 113) |

The accompanying table also shows the effect of adding brilliant cresyl blue to the $CoH_2I$ oxidation. It appears that the ability of the dye to inhibit or activate the $CoH_2I$ oxidation depends on the state of activity of the natural carriers in the preparation. A similar observation has been made in the case of the succinoxidase system[6], in which brilliant cresyl blue was found to be the dye which transported hydrogen most rapidly in the inactive system and inhibited an active system the least. Although cytochrome *C* increased the oxygen uptake in the case of succinate plus the ninety-hour preparation, it had virtually no effect on the $CoH_2I$ oxidation at ninety-six hours. This is in agreement with the findings of Dewan and Green[2].

With reference to the possibility of reaction (5) as an intermediate step in reaction (4), it is highly significant that *M*/150 malonate had absolutely no effect on $CoH_2I$ oxidation as observed in the conditions in the table, while it produced 100 per cent inhibition in the case of succinate oxidation using the same enzyme preparation. Furthermore, it was found that fluoride strongly inhibited succinate oxidation in these experiments but had no effect on the initial rate in the case of $CoH_2I$ oxidation. Fluoride does not inhibit $CoH_2I$ oxidation; the rate of oxygen uptake actually becomes somewhat greater in this system when $CoH_2I$ is oxidized in the presence of fluoride. This is quite likely due to the fact that in the absence of fluoride, reaction (3) can proceed yielding pyruvic acid which can compete for the dihydrocozymase hydrogen. This explanation is further borne out by the fact that addition of magnesium ions, which are known to activate reaction (3), in the absence of fluoride, gives a further decrease in the rate of $CoH_2I$ oxygen uptake.

Additions of fumarate had no effect on the $CoH_2I$ oxidation in the conditions shown in the table, in the presence or absence of fluoride. These negative results can be explained by the probability that cytochrome was the limiting reactant in the fresh enzyme; but it must be observed that in the ninety-hour preparation there was enough succindehydrogenase and its carrier system to give an oxygen uptake of 70 cub. mm. in comparison with the 40 cub. mm. observed for the $CoH_2I$ oxidation. It is of course true that as the oxidase system becomes weaker, the competing effect of the α-glycerophosphate dehydrogenase in enzyme *B* probably becomes more pronounced.

These observations do not suggest that the 4-carbon catalysis theory of Szent-Györgyi is wrong. They merely point out that the enzyme diaphorase is a widely distributed, powerful, malonate-insensitive enzyme which catalyzes the transport of $CoH_2I$ hydrogen to natural carriers which are capable of bringing this hydrogen ultimately to oxygen. The known facts of fumarate catalysis and malonate inhibition in muscle respiration must somehow be reconciled with this observation. The fact that factors tending towards pyruvate formation lessen the oxygen uptake of the system studied here may be a clue as to the mechanism of fumarate catalysis and malonate inhibition. It is possible that fumarate catalysis is to be explained in terms of pyruvate removal. It should also be pointed out that the observation that rapid $CoH_2I$ oxidation can proceed without the action of succindehydrogenase does not prove that the oxidation of $CoH_2I$ does not involve succindehydrogenase in the intact system. Further work is being done in an attempt to establish the nature of the fumarate catalysis in the light of these results.

I am indebted to Prof. Hans v. Euler and to Dr. Erich Adler for laboratory facilities and helpful criticism during this work.

V. R. POTTER
(National Research Fellow).

Biokemiska Institutet,
Stockholm, Sweden.
Feb. 2.

[1] Adler, Euler and Hellström, *Sv. Vet. Akad. Ark. Kemi*, **12**, 1 (1937).
[2] Dewan and Green, *Biochem. J.*, **32**, 626 (1938).
[3] Straub, Corran and Green, NATURE, **142**, 119 (1938).
[4] Green and Dewan, *Biochem. J.*, **31**, 1069 (1937).
[5] Needham and Lu, *Biochem. J.*, **32**, 2040 (1938).
[6] Stotz and Hastings, *J. Biol. Chem.*, **118**, 479 (1937).
[7] Green, Needham and Dewan, *Biochem. J.*, **31**, 2327 (1937).

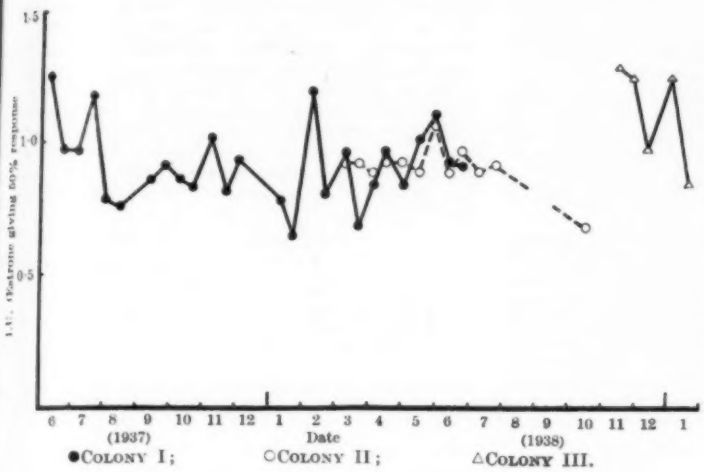
## Time-to-Time Variation in the Response of Ovariectomized Mice to Œstrone

IN NATURE of October 8, 1938, Duszyńska gave an account of seasonal variation in the response of ovariectomized mice to œstrone, and described an annual cycle of sensitivity which was greatest in spring and lowest in autumn. In the accompanying figure, I have plotted the variations in the dose of international standard œstrone needed to give 50 per cent positive responses when given by injection to groups of ovariectomized mice belonging to colonies kept at this Institute during the past twenty months.

A standard assay technique has been adhered to throughout the whole of this period, most of the determinations having been made with two or three groups of twenty mice each; but some with only a single group of twenty mice (notably those in which determinations for the first colony, denoted by black dots, overlap those for the second colony, denoted by open circles). Whilst an undoubted time-to-time variation in sensitivity occurs, it does not in this instance seem to follow any regular trend. It has been shown that mice which receive sufficient œstrogen to elicit a positive response within six weeks before use are fully 'primed'[1]. The mice in question were therefore uniform in that all groups had received œstrogenic material in sufficient amount within the necessary period before their use as controls.

The colonies have been kept at a fairly uniform temperature, but were exposed to the normal changes in daylight. Attempts to discover the causes of sensitivity changes have shown, however, that mice

kept in an ice-chest and in continuous darkness give the same response as the normal controls, while those continuously illuminated throughout the test period show only a slightly decreased sensitivity. The changes which occur spontaneously are clearly greater than can be accounted for by alterations in heating or lighting. It would be interesting to know the exact conditions under which Duszyńska keeps her mice, since the nature of the cycle she finds suggests a correlation with an external factor which is not apparently influencing our own mice in any regular fashion.




C. W. EMMENS.

National Institute for Medical Research,
Hampstead, London, N.W.3.
Feb. 2.

[1] Emmens, *Med. Res. Coun. Sp. Rep. Ser.*, No. 234. In the Press. H.M. Stationery Office, London, 1939.

## The 'Fossula Spongiosa' in Reduviidæ

WIGGLESWORTH'S interesting letter[1], in reply to mine[2] on the subject of the 'fossula spongiosa' in Reduviidæ, induced me to undertake further investigations, which have demonstrated that Reduviidæ which do not have this tibial structure are more or less equally efficient in climbing smooth surfaces, such as the sides of a glass tube, as those in which it is present.

The genera and species used in the experiments were *Mendis semirufa* Stål (larvæ and adults), *Ectrychotes* sp. (adults), *Canthesancus helluo* Stål (adult), *Vesbius purpureus* Thunbg. (larvæ and adults), *Scipinia* sp. (larva and adult), *Velitra rubropicta* A. and S. (adult), *Cosmolestes picticeps* Stål (larvæ and adults), and *Rhinocoris* sp. (adult). Of these, only *Mendis*, *Canthesancus*, *Ectrychotes* and *Velitra* possess a 'fossula'.

My statement that the 'fossula spongiosa' in *Rhodnius* was probably a vestigial organ was based on the likelihood that this genus had not always subsisted on a diet of human blood, but had been, in common with the majority of other Reduviidæ, predators of other insects. Since the adoption of blood-sucking habits by *Rhodnius*, the 'fossula' would not function, either as an adhesive organ, or as an instrument for facilitating the capture of prey.

So far as I have been able to ascertain, the 'fossula spongiosa' is absent from those genera which possess tibiæ and femora armed with spines, and also from diurnal genera which prey chiefly on sluggish insects (lepidopterous larvæ) or stationary insects (Coccidæ—mealy bugs).

Some species of Reduviidæ are said to be phytophagous. It would be of considerable interest if it could be shown that the tibiæ of such species lack the 'fossula'.

N. C. E. MILLER.

Department of Agriculture,
Kuala Lumpur,
Federated Malay States.
Jan. 20.

[1] Wigglesworth, V. B., NATURE, 141, 974 (1938).
[2] Miller, N. C. E., NATURE, 141, 749 (1938).

## Increasing Winter Egg-Production in Spain more than a Hundred Years Ago

WHEN announcing in 1932[1] that the reproduction of a mammal (*Microtus*) could be controlled by the duration of artificial illumination, R. M. Ranson and I published a statement that lights were used in poultry-houses in Spain more than a century ago for the purpose of increasing egg-production. Since then I have from time to time been asked for our authority for this statement. In view of the growing interest in the relation between light and reproduction, it may be worth while to give further particulars.

In 1803, Francisco Dieste published a book in Madrid, in which he described the practice of poultry-farming in Spain at that time. He says, ". . . it is necessary that the keeper disturb them [the hens] in their sleep and make them go to the trough at which there should be lights or torches of wood or other material so that the birds may see the food. In a week's time or so the hens will get accustomed to eat at that hour and come running as soon as they see the light". This translation from the Spanish is taken from Prof. S. Castelló's communication on the subject to the Second World's Poultry Congress and Exhibition held at Barcelona in 1924. Dieste himself considered that the lights were only useful in enabling the birds to eat more than would otherwise be possible during the winter.

I wish to express my obligation to Sir Edward Brown, Mr. E. T. Brown and Mr. Walter Brett (editor of the *Smallholder*) for their valuable help in obtaining this information about the early use of extra illumination in connexion with reproduction.

JOHN R. BAKER.

Dept. of Zoology and Comparative Anatomy,
University Museum,
Oxford. Feb. 11.

[1] Baker, J. R., and Ranson, R. M., *Proc. Roy. Soc.*, B, 110, 313 (1932).

## Terminology in Biology

DR. C. D. DARLINGTON[1] raises a very important point in his condemnation of words which should be dead but are still in biological currency. Every teacher and every author of a text-book will sympathize. The beginner in biology has a hard enough task without having to be plagued by a spate of alternative terms, an infliction which too often leads him to think that all he has to do is to learn these terms and their synonyms in order to 'know' his subject. To many students, a thing is known and understood as soon as a label has been attached to it. There is little wonder that biology is so subject to the reproach that it is nothing but a jumble of difficult words.

Unfortunately we are in a vicious circle. The teacher feels bound to give the alternative terms in case the student comes across them in his reading, and the author of a text-book considers it his duty to give the synonyms because teachers vary in their usage. Unless something is done, we shall have with us for evermore 'anterior vena cava', 'superior vena cava' and 'precaval vein'; and 'antherozoid' and 'spermatozoid'; and the host of alternative names for the female gametes of plants.

Cannot biologists get together and draft a list, with clear definitions, of the technical terms in common usage in botany and zoology? The selection should not be based on priority of introduction, but on commonsense suitability and expressiveness (for example, 'neural tube' is surely more understandable to the student than is 'medullary tube', and 'antheridium' is certainly preferable to 'pollinodium'). Possibly the British Association could take up this matter, or maybe the Association of British Zoologists would be willing to co-operate with a group of botanists in an attempt to clean up the present confusion.

B. BARNES.
C. C. HENTSCHEL.

Chelsea Polytechnic,
Manresa Road,
London, S.W.3.
Feb. 7.

[1] NATURE, 143, 206 (1939).

## Points from Foregoing Letters

THE possibility of an evaporation of neutrons in connexion with the recently discovered explosion of the uranium nucleus after neutron impact is discussed by Dr. H. von Halban, jun., Prof. F. Joliot and Dr. L. Kowarski. The density distribution of thermal neutrons obtained by slowing down photo-neutrons from a Ra $\gamma$ - Be source was studied in a solution of uranyl nitrate and in an equivalent solution of ammonium nitrate. At great distances from the source the uranyl solution showed an excess interpreted as a proof of the existence of the effect discussed.

Prof. L. Meitner and Dr. O. R. Frisch have collected recoil nuclei resulting from the fission of uranium nuclei, by placing a water surface near the bombarded uranium layer. From chemical tests and decay curves, the authors conclude that a considerable part of the collected activity corresponds to the 'trans-uranium' elements previously studied by Hahn, Meitner and Strassmann. Consequently the 'trans-uranium' decay periods must result from a fission of the uranium nucleus and therefore have to be assigned to elements considerably lighter than uranium.

Experiments are described by Prof. E. Friedmann, A. K. Solomon and N. T. Werthessen which give the relative amounts of radioactive bromine $^{82}$Br introduced into organic compounds by means of two processes—Sandmeyer's reaction and the addition of bromine to a double bond. The second method yields a higher concentration of radioactivity.

S. R. Craxford, G. H. Twigg and Prof. Eric K. Rideal point out that, contrary to the views of L. and A. Farkas in the catalytic exchange reaction between deuterium and olefines, the elementary step involves the addition of a deuterium atom and not a loss of a hydrogen atom. There is also evidence that in the chemisorption and rupture of saturated hydrocarbons on a catalyst surface, chemisorbed hydrogen plays a part. If this receives confirmation, a simple mechanism can be proposed permitting an interpretation of the great variety of chemical reactions which hydrocarbons can undergo at catalyst surfaces.

Dr. A. Neuberger contends that the evidence for the cyclol hypothesis, derived from the phenomena of denaturation, of molecular weights and regularities in the amino acid composition of proteins, can be otherwise interpreted. He claims that one may arrive at a globular structure for the protein molecule by postulating, instead of cyclol bonds, other types of bonds which are already known to exist. A reply to Neuberger's suggestions is given by Dr. Dorothy Wrinch on p. 482.

The biological activity of various fractions of a whale-liver oil concentrate (fractionated by adsorption in a calcium hydroxide column) is found by H. Willstaedt and Dr. H. B. Jensen to be considerably lower than would have been expected from the antimony trichloride reaction, but greater than shown by the ultra-violet absorption. Apparently the whale-liver oil does not contain the active substance with an absorption maximum at 344 m$\mu$ but may contain another hitherto unknown substance having the biological action of vitamin A.

The liberation of negative ions from a wire gauze inserted between the cathode and the first slit of a mass-spectrograph is reported by R. H. Sloane and Miss Eliza B. Cathcart. The ions so emitted under negative ion bombardment, like those produced by positive ion bombardment, show excess energies.

The role of the enzyme diaphorase as a hydrogen carrier is discussed by V. R. Potter, who concludes that diaphorase is a widely distributed, powerful, malonate-insensitive enzyme which catalyses the transport of hydrogen from dihydrocozymase I to natural carriers capable of bringing this hydrogen ultimately into combination with oxygen.

C. W. Emmens reports that, while his colonies of ovariectomized mice exhibit time-to-time variation in sensitivity to injected œstrone, the variations do not show any regular trend.

# Research Items

### Early Settlers in Virginia

In the course of the recent meeting of the American Association for the Advancement of Science, at Richmond, Va., during December 27–31, R. Bennett Dean presented a study of early settlements of various nationals in the Colony. Of the French the first to land came with the Governor, Lord De la Warr, in 1610. They planted vines and mulberry groves and were responsible for the establishment of the silk industry. In succeeding years of the seventeenth century, great numbers of Huguenots followed, especially from Saintonge, Languedoc and the Gironde; but the greatest single movement took place about 1700, when on one occasion four boats with about eight hundred passengers sailed from London. After the revocation of the edict of Nantes in 1685 more than 1,000 settled at Mannakin on the upper James. By 1800 the French had spread to nearly every community in Virginia. The highest percentage is now in Powhattan county. Four Germans were in the first boat to arrive at Jamestown. By 1623 there were at least 109 German, Swiss and Dutch, chiefly, artisan, settlers in Virginia. Two thousand immigrants from the Rhenish Palatinate in 1707 were the ancestors of the settlers in the Valley of Virginia. Between 1690 and 1716, the persecution of the Protestants in Germany brought settlers to the forks of the Potomac. Some afterwards moved into the Shenandoah valley. These now are the areas with the highest percentage of Germans. One of the earliest settlements of the Scots was in 1649, when 320 Royalists arrived. In 1732 Scots, largely from Pennsylvania, entered the Valley, founding Presbyterianism in the United States. More numerous and more active than the Germans, they spread over and outside the State, and were an effective buffer against the Indians along the Alleghanies, enabling the colonists to consolidate their gains. In the earlier period of its history, Richmond was entirely occupied by Scots.

### Mbali of Southern Angola

THE designation 'Mbali', according to the interpretation given by the people themselves, means 'civilized black'. These people may be defined, according to the Rev. P. E. C. Estermann (*Africa*, 12, 1; 1939), as descendants of former slaves, who through employment on plantations, have assimilated a large number of the cultural elements of their old masters, and at the present day readily take to earning their livelihood among the Whites as domestics and artisans. The language of this people, originally of a mixed origin, is Kimbundu, mingled plentifully with Bantuized Portuguese terms. Their material culture has almost completely given way to elements which have been imported from Europe; but in mentality and in beliefs they are still predominantly Bantu. This appears especially clearly in their behaviour in relation to sickness and death. Belief in the incidence of sickness as due to the action of sorcerers is general. The medicine man is as much diviner as healer. The Mbali resort to them no less readily than do other natives, though the ritual employed differs in details, more especially in the introduction of certain Christian features. The healing ceremonial culminates in a sacrifice of a victim which is killed by the patient after the onset of 'possession'. As the victim falls, the patient throws himself upon it and drinks the warm blood. In burial ceremonial, before the body is committed to the grave, the widespread Bantu rite of interrogation of the dead is performed. Two men raise the shroud, while a third asks the deceased who has been responsible for his death, slaying him by sorcery. If the sorcerer is present, this will be indicated by the movement of the shroud. If the person indicated is a man of courage or position, the accusation may be ignored. If, however, it should be a person of inferior standing, it may be that to avoid the consequent unpleasantness he will have to leave the country. Mourning lasts a fortnight and is brought to a close by a feast held at night, in which dances are accompanied by obscene songs.

### Double Monsters

PROF. TAKU KOMAI and his colleagues have issued a series of four papers (*Mem. Coll. Sci. Kyoto Imper. Univ.*, B, 19, 155–253; 1938) dealing with the various types of twins and double monsters which occur in fishes, reptiles, birds and mammals. The literature is reviewed, and several new instances are given. The problem of situs inversus viscerum is recounted in some detail for fish embryos, and Komai comes to the conclusion that this curious derangement is associated with a disturbance of the normal developmental process and is due to a general, rather than a local, cause. There would appear to be a physiological gradient passing from the left to the right side of a fish embryo; and the derangement of this gradient brings about the situs inversus viscerum. Craniopagus, a rare form of duplicity in snakes, is described for *Hemibungarus japonicus*. The numerous types of katadidymi in chicks and ducklings are surveyed and tabulated in detail. Five specimens of mammalian double monsters are recorded. The many illustrations add to the usefulness of these papers.

### Hæmoglobin Production in Anæmia

P. F. Hahn and G. H. Whipple (*J. Exp. Med.*, 69, 315; 1939) find that a low protein intake causes limited hæmoglobin production in anæmic dogs. The dog on a limited protein intake was unable to produce the usual amount of globin and therefore of hæmoglobin even in the presence of a large amount of iron. The same result was obtained whether the iron was given by mouth or intravenously, the dog, made anæmic by withdrawal of blood, being unable to produce the expected new hæmoglobin related to the iron intake when the protein intake was kept at low levels. The dogs could be kept in perfect health and weight equilibrium during these long periods of limited diet intake and anæmia. Under the stress of protein limitation, the proteins of salmon muscle, banana and carrot were well utilized, and only 7–8 gm. of these food proteins were required to produce 1 gm. of new hæmoglobin. These experiments clearly showed that the iron content of liver was not wholly responsible for its potency in anæmia due to hæmorrhage.

### Reptiles and Amphibians of the Sahara

WE think of the Sahara as a region in which vegetation and, along with it, animal population are reduced to a minimum, yet in his two missions of exploration (1929–32 and 1934–35) H. Lhote contrived to capture alive 35 specimens of snakes, 115 lizards and 76 amphibians. His journeys traversed the Sahara from north to south, but they also touched the Sudan, and that to some extent accounts for the numbers of his specimens. With F. Angel he now describes the collections as representing the following numbers of species and subspecies: one crocodile and one chelonian, 25 lizards, 17 snakes, 8 frogs and toads (*Bull. Com. d'Etud. Hist. Sci. Afrique Occ. Française*, **21**, 345; 1938). Several of the species are described as new to science. Perhaps the most interesting part of an ecological region of great diversity is the area Tanezrouft and Ténéré, the most desert of all the Sahara, forming a belt from Atlantic to Red Sea, which is an impassable barrier to all small species. Here the fauna is reduced to small forms able to subsist upon the sparse and scattered tufts of vegetation. The oases also constitute regions of ecological interest, for these isles of man-planted vegetation, lost in a vast sea of sand, form the only areas which can preserve the amphibians still persisting in the Sahara.

### Evolution and Relationships of Elasmobranchs

J. A. MOY-THOMAS has recently reviewed the considerable amount of modern work on early fossil fishes and put forward his views regarding the evolution and relationships of the elasmobranchs (*Biol. Rev.*, Jan. 1939). Elasmobranchii has been used as synonymous with Chondrichthyes and not in the sense that it is used by some authors, who include in it a number of other early groups which the author, with justification, considers to be not closely related. The group arose in the Upper Devonian, and *Cladoselache* represents an approximation to the ancestral form. They early differentiated into two lines separable, *inter alia*, by their tooth structure, the Selachii and the Brachyodonti; the former having been derived from the Cladoselachii and including the living elasmobranchs, sharks, skates, rays, etc. The origin of the latter is not so clear, and their living representatives are the Holocephali. Reasons are given for regarding the Acanthodii, Arthodira and other placoderms as not closely related to the elasmobranchs. They are a diverse group, with a number of characters in common, and are at a lower grade of evolution than the elasmobranchs.

### Effect of Eupolyploidy on Chloroplasts

EUPOLYPLOIDY in plants induces certain hereditable changes such as increase in amount of nucleolar substance, increase in size of nucleus, amount of cytoplasm, volume of cells, etc. The size of the plants themselves is also affected; but the relation between euploid chromosome alteration and size varies, since some euploid plants are larger whereas others are smaller. The effect of eupolyploidy on the size of the chloroplasts has recently been studied by D. Kostoff and A. Orlov, working on *Nicotiana* and *Solanum* (*Ann. Bot.*, New Series, **2**, No. 8, 883; 1938). From the data obtained, it is clear that chloroplasts do not increase with an increase in the chromosome number. In fact, there is a tendency to smaller size than in the diploids or in the parental species. In only one case (*N. rustica* × *paniculata*) was the average diameter of the chloroplasts of the amphidiploid larger than the average diameter of those of the parent species. Since tetraploids are usually deeper green in colour, the colour difference is probably due to a larger number of chloroplasts in the cell.

### Seeding from Severed Shoots

A DISCOVERY of importance to the farmer and gardener is the fact that once the flowers are open some of the common weeds can ripen their seeds on the severed shoot just as well as on the growing plant. N. T. Gill has carried out investigations into this question (*Ann. App. Biol.*, **25**), and an account of his results is also given in the *Gardener's Chronicle* (No. 2716, **105**). The most dangerous weeds in this respect are ragwort and sow thistle, for seed from cut shoots of these species showed as good viability as when allowed to ripen completely on the parent plant. Cut shoots of groundsel, on the other hand, gave only 35 per cent germination compared with 90 per cent from ripened seed. Other weed seeds such as dandelion, cat's-ear, creeping thistle, curled dock and stinging nettle can only germinate if the seeds are fully developed, but the inconspicuous nature of the flowers in some of these plants makes it unwise to assume that it is safe to leave cut portions on the ground. The stage of maturity may also exert an influence on the length of dormancy of the seed. In the case of shepherd's purse, mature seeds can germinate in the autumn or spring, but half-ripe seeds wait until the spring. Corn speedwell and chickweed showed the same behaviour. *Datura stramonium*, on the other hand, behaved quite differently, for ripe seeds either germinated at once or lost their viability after four weeks, whereas immature seeds retained their germinative capacity for a year or more.

### Frost Damage to Fruit Trees

THE serious reductions in crop suffered by fruit growers in recent years have led the Ministry of Agriculture to institute an inquiry into the effect of meteorological factors on the distribution of frost damage. Preliminary results obtained by C. E. Cornford have recently appeared (*J. Pom. and Hort. Sci.*, **16**, 291; 1939). A study of micro-climate in relation to topography has brought out several interesting facts which may be of importance in attempts to combat frost injury. On certain clear nights when a calm exists in valleys, the occurrence of a light and relatively warm 'hill-top wind' has been demonstrated. This is able to influence the force and direction of a local katabatic wind on a neighbouring slope, producing a calm belt or 'neutral zone' across the slope, or a movement of air along the contours, according as the wind blows directly or obliquely on the slope. Such a calm belt may be a suitable site for orchard heaters. It was shown that on most radiation nights the air temperature over undulating country varied with altitude, the highest places being the warmest. The temperature, however, measured at a height of 3 ft. above the ground, was equally affected by the nature of the vegetation. The lowest minimum temperatures occurred over grassland, whilst the air above bare soil and that in woods with a complete leaf canopy was relatively warm, often 6° F. above that over grassland. Only exposed grass was able to produce relatively cold air above it on a radiation night, grass under trees in a leafy apple orchard causing no reduction. It is suggested that risk of frost damage in an orchard in the blossoming period may be reduced by reducing the amount of long grass exposed to the sky.

### Anomalous Dispersion of Rayleigh Waves

THIS is the subject of a second paper on "Anomalous Dispersion of Elastic Waves" by K. Sezawa and K. Kanai (*Bulletin Earthquake Research Institute, Tokyo Imperial University*, **14**, Part 4, November 1938). The densities and elastic constants of the surface layer and the subjacent material are symbolized, and the velocity equation of dispersive Rayleigh waves is determined in terms of these. Six cases of $\mu'/\mu$ ranging from 1 to 0·4 are then assumed and the consequences investigated. It is found that when the stratification approximates to Wiechert's condition ($\varphi'/\varphi = \mu'/\mu = \lambda'/\lambda$), the velocity of Rayleigh waves for an intermediate value of $L/H$ is considerably higher than that of the usual Rayleigh waves. In this particular instance there is a second dispersion curve that passes through the point corresponding to the velocity of Stonely waves. As the stratification approaches the usual type, the dispersion curve tends to assume the normal dispersion type. When density increases with depth more rapidly than elasticity, as may often occur in the earth, the dispersion curve becomes quite anomalous, and beyond a certain critical condition there should exist a range of $L/H$ within which no surface waves of permanent type can exist.

### Deep-Focus Earthquakes in Central Asia

S. P. LEE has made a study of four of these shocks occurring between 1933 and 1935, using data obtained from seismograms (*Seis. Bull.*, Chiufeng, China, Seismic Station, **3**, Nos. 2 and 3; 1935 [received 1938]). The shocks were chosen by their characteristics as enumerated by Scrase and chiefly by their lack of notable *l* and *m* phases. The method of investigation was first to find the epicentre by assuming the travel time ($T$) of the $P$ wave to be connected with the epicentral distance ($\triangle$) by the formula $T = A + B\triangle + C(\triangle/10)^3$ and fitting in the constants $A$, $B$ and $C$ by the method of least squares, afterwards applying the Geiger method to correct the approximately determined epicentre. The depth of focus was then determined by four methods: (1) from first principles, (2) by the Brunner chart, (3) by Scrase's method, (4) by the time interval between *PKKS* and *P'*. The results for the four shocks obtained by the author were as follows: (1) Epicentre $\varphi$ 35° 29′, $\lambda$ 70° 05′, $T_0$ 1933 Jan. 9d. 2h. 1m. 38s.; depth of focus, 0·045 of earth's radius. (2) Epicentre $\varphi$ 36·1°, $\lambda$ 70·7°, $T_0$ 1935 Feb. 3d. 2h. 10m. 42s., depth of focus 0·023 of earth's radius. (3) Epicentre $\varphi$ 36·4°, $\lambda$ 70·8°, $T_0$ 1935 April 3d. 11h. 11m. 56s., depth of focus 0·031 of earth's radius. (4) Epicentre $\varphi$ 38·1°, $\lambda$ 70·9°, $T_0$ 1935 Oct. 11d. 4h. 20m. 31s., depth of focus 0·047 of earth's radius. The author notes that the epicentres are all near $\varphi$ 36°, $\lambda$ 70°, near the inflexion of the Hindu Kush, and proposes to investigate the method of origin further.

### Crystal Structure of Ammonium Cadmium Chloride

IN crystalline cadmium chloride $CdCl_2$, there are octahedral $CdCl_6$ groups condensed into layers, each chlorine atom being adjacent to three cadmium atoms. Tetrahedral co-ordination is shown by cadmium with cyanide groups in $K_2Cd(CN)_4$ and with sulphur, selenium and tellurium atoms in the sphalerite and wurtzite type crystals CdS, CdSe and CdTe, and might occur with chlorine also. There are hence two types of structures which might well occur for the complexes $(CdCl_2)_x$, the first involving octahedra with shared corners, as in the cubic crystal $KMgF_3$, and the second involving rings or chains of tetrahedra as in the metasilicates. H. Brasseur and L. Pauling (*J. Amer. Chem. Soc.*, **60**, 2886; 1938) have determined completely the structure of the orthorhombic crystal $NH_4CdCl_3$ and find it to be based on octahedral configuration about the cadmium atoms. The $CdCl_6$ complexes occur in the crystal in infinite polymers in the form of double rutile strings of $CdCl_6$ octahedra parallel to the *c*-axis. These complexes are held together by the ammonium ions, each of which has nine chlorine atoms co-ordinated about it. Interatomic distances in the crystal are found to be closely related to those in $CdCl_2$ and $NH_4Cl$.

### Large Cosmic Ray Showers

P. Auger, R. Maze, P. Ehrenfest and A. Fréon (*J. de Phys.*, **10**, 39; 1939) have investigated very large showers of particles produced in the atmosphere by the cosmic rays. They find that Geiger counters separated by quite large distances (up to 75 m.) show occasional coincident discharges. The frequency of these extensive showers increases with altitude at much the same rate as the ordinary showers produced in heavy metals. It was concluded from the counter experiments that the density of particles in a shower was of the order of 50 per sq. metre, and a very similar result was obtained by the use of an expansion chamber released by the coincidences (cf. Jánossy and Lovell, NATURE, **142**, 716; 1938). A great part of each shower consists of electrons, as shown by absorption and by the cascade multiplication of the particles in a lead plate. The authors consider that there are some penetrating particles present, though it seems possible that their absorption curves are not incompatible with a shower containing only electrons of fairly high energy. There seem to be some protons produced by nuclear interaction. The showers observed are probably part of large cascades produced by the multiplication in the atmosphere of an incident electron of very high energy. Assuming that this is so, the initial energy must be of the order $10^{13} - 10^{14}$ electron volts. It may be remarked that this is much larger than the energy which could be obtained by the complete annihilation of the heaviest atoms.

### An Improved Liquid-Filled Prism

F. J. HARGREAVES has recently described his hollow liquid-filled prism of about 3¾ in. effective aperture, the glass plates constituting the refracting sides of the prism being joined at their edges to the cell by goldbeaters' skin (*Mon. Not. Roy. Astro Soc.*, **99**, 2; 1938). The object of this flexible connexion is to prevent stresses in the plates, each of which presses against external stops and is held there by the pressure of the dispersing liquid within the cell. A difficulty arose in supporting the weight of the glass plates, more especially as it is necessary to invert the prism to empty it. To prevent too much tension on the goldbeaters' skin supplementary support was provided by the use of slings made of phosphor-bronze wire. Another prism is under the process of construction on the same principle but with minor modifications in detail. The author sees no reason why much larger prisms should not be made on similar lines, though there is the difficulty of constructing large disks that are thin and homogeneous. Hargreaves thinks that this difficulty can easily be overcome.

# The Structure of the Globular Proteins

By Dr. Dorothy Wrinch

ON recent occasions a number of objections to the cyclol theory have been raised, to many of which replies have already been given, explicitly or implicitly, in a number of publications, notably in Langmuir's lecture to the Physical Society on December 20, 1938[1]. In view of the prominence which has been given to these criticisms, it seems desirable to summarize the replies.

It has been suggested that the number of theories such as the cyclol theory is so large that the *a priori* probability of any one is not sufficiently great for it to merit consideration[2,3]. It is difficult to give much weight to objections of this type until it proves possible to formulate, or failing this to establish the existence of, a sufficiently large number of independent theories, each of which leads to structures accounting for the definite and discretely arranged molecular weights of the native proteins, their capacity to denature, to form spontaneously from solution highly insoluble monolayers and so on. So far as we are aware, no alternative structures have yet been proposed. Meanwhile, "the very large number of independent properties which are correlated by the cyclol theory and the extreme simplicity and the small number of postulates from which it is derived by purely logical processes"[1], seem to give it a considerable *a posteriori* probability.

It is suggested that there are grave objections on chemical grounds to the postulate of the four-armed unit >N-CHR-COH< [3] and indeed to the cyclol structure itself owing to the lack of precedent in organic chemistry for this diazine-triazine type of structure[4]. Proteins are so different from other substances that it is surprising that there is a reluctance to accept for them a structure for which no analogue in organic chemistry can be found. Globular proteins have not yet been synthesized in the laboratory. The fact that it has not proved possible to form ring structures from peptides[5] is therefore scarcely to be regarded as evidence against the cyclol hypothesis. Furthermore, we would not regard the lactam-lactim tautomerism of peptides as the chemical basis of the cyclol theory[4]. At present, we do not know whether polypeptide chains constitute an intermediate stage in protein synthesis, nor is it clear that the cyclization of chains, if it occurs, entails the postulate of lactam-lactim tautomerism of peptides.

Further criticisms of the cyclol hypothesis are as follows: (*a*) the theory is incompatible with the findings of enzyme chemistry[4,6]; (*b*) it cannot explain certain facts of denaturation[4]; and (*c*) it has not proved possible to synthesize in the laboratory certain "simple models of cyclol type"[4], or to induce the formation of cyclol links between simple molecules[6].

(*a*) In accordance with the current ideas in the kinetics of reactions, it was suggested by Langmuir[7] that there is a tautomeric equilibrium in the globular proteins between some of the four-armed units >COH-CHR-N< and the two-armed units -CO-CHR-NH,- by means of which cyclol bonds are continually opening and reforming. Thus at any one time there are some points at which a peptide link, CO-NH, can be attacked directly. The cyclol theory therefore does not, as has been suggested[4], need to make the assumption that proteolytic enzymes open cyclol bonds. We know of no evidence which conflicts with the view that the enzyme can take advantage of the situation arising from the opening of these bonds, so that, if it is a fact that proteolytic enzymes act only on CO-NH bonds, there is no incompatibility with the cyclol structure proposed for the globular proteins.

The objections (*b*) and (*c*) again raise the question of the nature of the cyclol bond. This bond in isolation may well be unstable; indeed the marked instability of the globular proteins in general and other considerations[8] require it to be so. Failure to synthesize in the laboratory so-called "simple models of the cyclol type"[4] (a phrase which may ultimately be found to be a contradiction in terms), or to induce the formation of isolated intermolecular cyclol links, is then no evidence against the cyclol hypothesis.

The stability of the globular proteins, under special conditions, in solution and in the crystal, we attribute to definite stabilizing factors[7,9]; namely, (1) hydrogen bonds between the oxygens of certain of the triazine rings, (2) the multiple paths of linkage between atoms in the fabric, (3) the closing of the fabric into a polyhedral surface which eliminates boundaries of the fabric and greatly increases the symmetry, and (4) the coalescence of the hydrophobic groups in the interior of the cage. If these stabilizing factors are withdrawn the cage structure collapses. Denaturation on this theory (apart from the special type due to the dissociation of structures held together by hydroxyl or hydrogen bonds or salt or covalent linkages between *R*-groups[10,11]), corresponds to any breakdown of the structure due to the opening of cyclol bonds[1,12]. When few bonds are open they may re-form because of the multiple paths of binding holding the parts in position. Reversible denaturation (of either type) is thus not excluded by the cyclol theory. In the case of the fibrous proteins in which some cyclol bonds may be present,[13] the first and second stabilizing factors may operate. The denaturation of myosin (which it is suggested is a difficulty for the cyclol theory[4]) thus seems to be easily interpretable.

The first stability factor also, it appears, may explain the fact that it has not proved possible to methylate or acetylate the peptide hydroxyls, which on the present hypothesis should be present in egg albumin and hæmoglobin[14].

It may be emphasized that whereas the first three stability factors are uniform for all the globular proteins, the strength of the fourth factor varies with the specific amino-acid composition of the individual protein. This point is demonstrated by the case of insulin, in which the exceptional behaviour (its resistance towards heat and acid, the stability of its crystals in the dry state, etc.) can perhaps be correlated with its abnormally high content of hydrophobic groups. The fact that insulin "cannot be denatured in the usual sense of the word"[4] does not

provide evidence against the cyclol theory of denaturation: it illustrates the importance of the fourth stability factor. Incidentally, insulin, like many other globular proteins, spontaneously forms very insoluble monolayers from solution[15], a property which in itself indicates the likelihood of a cage structure[1,10,11]. The spontaneous formation of monolayers from solution represents a very mild type of degradation, presumably involving no hydrolysis. It seems likely that much could be learnt about protein structure by studying the structure of the constituents of these protein monolayers. On the cyclol theory, fragments of fabric and closed polypeptide chains are to be expected when gentle methods of degradation are used which involve no hydrolysis[12]. The theory would not (as has been suggested[4]) make any predictions as to the nature of the products obtained when the usual gross methods of degrading proteins are used.

Other criticisms of the cyclol theory[3] (dealt with in detail in other communications[16,17]) relate to one particular point, namely, the suggestion that the insulin molecule has the cage structure $C_2$. It was shown at the outset[10] that this structure satisfies the chemical and physico-chemical facts and also those relating to cell molecular weight, space-group and cell dimensions obtained in an X-ray analysis of a dry zinc-insulin crystal[19]. Controversy has, however, arisen as to whether it is consistent with certain vector diagrams of a dry zinc-insulin crystal published later[20]. In view of authoritative opinions as to the inadequacy of the X-ray data[21] (which make it highly uncertain how far the vector diagrams give even an approximately correct picture of the situation in the crystal) and as to the feasibility of making any deductions from such data in the absence of a chemical analysis of the crystal[21,22], it seems necessary at present to abandon the hope of reaching any final conclusion on this special point. Arguments can only revolve round the plausibility of subsidiary hypotheses.

## The Geometrical Attack on Protein Structure

It has been pointed out by Neuberger[4] that many of the arguments in favour of the cyclol hypothesis could be used equally well in favour of any "regular geometrical structure which joins peptide chains to form a globular molecule", a theme which has already been developed in considerable detail[23,24]. This remark, in focusing attention on the fundamental problem of protein structure, namely, the existence of megamolecules, puts into correct perspective the general investigations on protein structure of which those dealing with the cyclol theory form a part. These investigations have a wide scope. Given that protein molecules are polycondensation products of amino acids, interlinked by bonds between the nitrogen of one and the terminal carbon of another, there are only a certain mathematically determinate set of possible structures. The full and exhaustive formulation of these is the objective of this work[11,12,24].

Now the cyclol theory gives precise expression to this general point of view by postulating that these polycondensation products are built on the particular two-dimensional scheme exemplified by the cyclol network. No alternative comprehensive scheme has so far been forthcoming; but on the other hand, it has never been claimed that the cyclol pattern is the only design consistent with the chemical and stereochemical specifications[24]. The characteristic pattern must, of course, satisfy certain conditions; thus it must be such as to allow "the possibility of the regular and orderly arrangement of hundreds of residues"[25] (and herein lies the difficulty of attributing the fine structure of proteins to S–S, CO–S,NH–S or CO–NH–CO links as suggested by Neuberger[4]), and it must be capable of fragmentation into polypeptide chains. The cyclol postulate has been developed in considerable detail, since it was scarcely feasible to show the potentialities of the geometrical method by general statements alone.

It should, however, be recognized that there are broad deductions to be drawn from this point of view, irrespective of the particular form of the atomic pattern. Chief among these is the suggestion that the molecules of the globular proteins are cage-like structures, consisting of a characteristic fabric folded round to form a closed polyhedral surface[10,12,24]. This simple corollary of the idea of a protein fabric, though in point of fact suggested by the cyclol hypothesis, is independent of this or any other postulate. Whether or not the cyclol hypothesis proves to be correct, it certainly establishes the existence theorem in the mathematical sense, proving that there are no intrinsic impossibilities in the cage type of structure, showing how the atomic pattern can determine size and shape, and proving also that the cages may be rendered highly specific by the conditions of linkage imposed on the individual atoms.

The present controversy—wholly concerned with details of the cyclol pattern—makes it clear that the determination of the atomic pattern of proteins is beyond the range of present chemical and physical techniques. It then seems all the more important to direct attention to this general issue as to the general nature of structures of the globular proteins. Whatever the atomic pattern may be, the fact remains that the defining characteristics of the native proteins not only fit in with the idea of a cage, but even seem to demand a structure of this kind for their molecules. On this point there seems indeed to be a growing consensus of opinion[2,4]. In any case, the central problem is to explain the existence of very large but chemically and physically well-defined molecules. The idea of a cage structure has been offered for consideration, as an explanation of this striking fact. Is it not possible, by means of experimental techniques already available, to recognize a cage when we see one?

[1] This lecture was summarized in NATURE, **143**, 34 (1939): it will be published in full in the *Proceedings of the Physical Society*.
[2] Bernal, Royal Institution, Jan. 27, 1939.
[3] Bernal, NATURE, **143**, 74 (1939).
[4] Neuberger, NATURE [this issue p. 473].
[5] Neuberger, NATURE, **142**, 1024 (1938).
[6] Bergmann and Niemann, "Annual Reviews of Biochemistry", 7, 11 (1938).
[7] Cold Spring Harbor Symposium on Proteins, **6** (1938).
[8] Wrinch, NATURE, **138**, 241 (1936).
[9] Langmuir and Wrinch, NATURE, **143**, 49 (1939).
[10] Wrinch, *Proc. Roy. Soc.*, A, **161**, 505 (1937).
[11] Wrinch, *Phil. Mag.*, **23**, 313 (1938).
[12] Wrinch, *Phil. Mag.*, **25**, 705 (1938).
[13] Wrinch, *Proc. Roy. Soc.*, A, **160**, 81, 1937.
[14] Haurowitz, *Z. physiol. Chem.*, **256**, 28 (1938).
[15] Langmuir, Pilgrim Lecture, Royal Society, November 8, 1938.
[16] NATURE [forthcoming].
[17] Langmuir and Wrinch, *Proc. Phys. Soc.* [in course of publication].
[18] Wrinch, *Science*, **85**, 568 (1937); *Trans. Faraday Soc.*, **33**, 1368 (1937).
[19] Crowfoot, NATURE, **135**, 591 (1935).
[20] Crowfoot, *Proc. Roy. Soc.*, A, **164**, 580 (1938).
[21] Robertson, NATURE, **143**, 75 (1939).
[22] Bragg, NATURE, **143**, 73 (1939).
[23] Wrinch, International Congress of Physics, Chemistry and Biology, Paris, 1937.
[24] Wrinch, Cold Spring Harbor Symposium on Proteins, **6** (1938).
[25] Wrinch, NATURE, **137**, 411 (1936).

# 'Stump' Planting

AS regards modern developments of what is now widely alluded to as 'stump' planting, the method in all probability was first introduced to plant up new areas in connexion with the irrigated plantations in the Punjab plains, the species first utilized being the shisham (*Dalbergia Sissoo*). 'Stump' is really a misnomer; for the piece of the plant alluded to is a root and shoot or stem cutting. Its success and cheapness under certain conditions in the Punjab was striking, and this success has been repeated elsewhere in India, for example, in the Terai and Bhabar lands in the United Provinces, and in northern Nigeria in Africa with the same species.

But successful as has been the afforestation work with shisham stump planting, it has proved even more successful with teak in many parts of India, where artificial replanting or new afforestation work is being undertaken under certain types of condition. So valuable and cheap is the method that it has spread far beyond India, and interesting work has been obtained with stumps in the west coast and other forests of both British and French Colonies in Africa.

In the past there has been a good deal of controversy as to the best size (length and thickness) of the root and shoot cutting or 'stump'. An ordinary method of obtaining these for planting out purposes in both India and Africa is to sow seed in a nursery and then root and shoot prune when one year old, leaving eight inches of root and one inch of stem. A. L. Griffith, the Madras sylviculturist, has now discussed an investigation into the best root length of stump to use when stump planting teak (*Tectona Grandis*) in areas having a general west coast type of climate (*Ind. For. Rec.*, New Ser., **3**, No. 1. Govt. of India Press, New Delhi, 1938).

From the details of the localities given it is obvious that by "west coast" the author means the west coast of India and not the west coast of Africa. But the experiments here discussed will prove of equal use in the latter region, where the introduction of stump planting is of a more recent date. The climate had an average annual rainfall varying from 60 in. to 120 in., and elevations varying from the plains at the foot of the Ghâts up to 3,000 ft. The soils at all centres were light forest soils naturally well aerated. Briefly, Mr. Griffith carried out a series of experiments in different localities over a period of four successive years (1932–1935). His results may be summarized as follows: There are no appreciable differences in results, at the end of the first growing season after planting, from stumps within the root length range of 6 in. to 10 in.; but a root length of 4 in. gives definitely poorer results. It was also demonstrated that stumps of 0·7–0·8 in. diameter give appreciably better results than those of 0·3–0·4 in. diameter.

# Intelligence and Birth-Rate

IN a paper entitled "Intelligence and Birth-Rate" read before the Industrial Section of the British Psychological Society on February 8, Dr. L. S. Penrose summarized the present position regarding differential fertility and the decline in intelligence alleged to be taking place in Great Britain. By examining the results of differential birth-rates within the community, he brings to light the trends of social selection that are taking place, and in doing so, he links together a number of facts not usually associated in considering these matters.

Although the general problems of a declining birth-rate, owing largely to the efforts of the Population Investigation Committee, are beginning to attract wide attention, the effects of a differential fertility upon the ability of the nation as a whole are far too little appreciated. Knowledge of the relation between intelligence and birth-rate, as Dr. Penrose says, is of great practical importance in "planning the conditions of an efficient civilization". Even the most critical writers have been compelled to admit the presence of some fall in national ability. Thus Prof. J. B. S. Haldane writes that we may "expect a slow decline perhaps of 1 or 2 per cent per generation in the mean intelligence quotient of the country". ("Heredity and Politics", p. 117.)

The subject of a decline in the nation's intelligence is one that lends itself easily to sensationalism, and the presentation of Dr. Penrose is to be welcomed as a dispassionate and timely one. At the outset he points out that the fall in the birth-rate may be due to diminution in family size, which implies a larger proportion of first-born children. Thus the average sibship in Great Britain now is said to be half of what it was fifty years ago.

Apparently, only in one type of mental defect, namely, that associated with lesions in the pyramidal tract, has Dr. Penrose been able to satisfy himself that primogeniture is a highly significant factor. But he admits the existence of evidence pointing to raised incidence, among the first-born, of abnormal confinements, still-births, and congenital malformations such as anencephaly, spina bifida and hydrocephalus. There is evidence also that first-born children more frequently tend to become problem children than the later born, though here other selective influences may be at work bringing the first-born children to the notice of the clinics. It has also been maintained that the first-born are more likely to become insane than the later born, and that the chances of being convicted of criminality are much greater in the first two members of a family than in the rest of the family.

Maternal age at the birth of a child is the next factor considered by Dr. Penrose. Where the birth-rate is falling, the average maternal age will probably become greater. Dr. Penrose estimates the average maternal age in England as 29 years; in Japan it is said to be 26 years. Maternal age is particularly significant in the etiology of mongolian imbecility, the chances of the occurrence of this kind of defect being more than doubled for every increase of five years after the age of twenty-five years. The chances of the birth of a mongolian imbecile before the maternal

age of 25 years are estimated by Dr. Penrose as about 1 in 6,000.

Other influences related to changes in intelligence level and discussed by Dr. Penrose are birth-rates in rural and urban populations. Fertility is higher in rural than in urban areas, and the average intelligence is generally found to be much lower in the country than in the towns. Actual mental deficiency is also found more frequently in rural than in urban districts. The main cause would presumably be the migrations of the more able people from the country to the town, where industrial development offers them greater economic inducement than is found in agricultural areas. An additional factor in the decline of fertility among certain classes has frequently been stressed. This is the high cost of education and general high standard of living. Yet another factor is the employment of women, usually the more intelligent ones, in industry and commerce.

Whatever effects social selection has upon the level and distribution of intelligence, it certainly seems to have favourable effects upon physique. Besides a marked reduction in the incidence of diseases like tuberculosis, a notable increase has taken place in the average height and weight of working-class school children. As regards the question of intelligence as an inheritable character, Dr. Penrose inclines to the view that the presence of a favourable environment may make a significant difference to the scores made on an intelligence test.

Dr. Penrose leaves open the possibility of an I.Q. of 90 becoming normal with an improved environment. Some psychologists would consider this as somewhat too high an estimate of the possible effects of environment upon the scores of an intelligence test. He concludes that "on account of social selection, the intelligence level of the general community tends to move towards the point at which fertility is highest". He takes, however, a more moderate view of the point of highest fertility than other writers and regards it as lying in the region of 90 (Binet I.Q.). In his view the "fecundity of the mentally defective is largely mythical" and those with an I.Q. below 70 have a fertility about one quarter of the normal.

Finally, Dr. Penrose is inclined to believe that the most immediate causes of differential fertility and also of general trends in birth-rate are probably psychological in nature. In this connexion it might be worth mentioning that a very recent investigation of Prof. L. M. Terman on marriage revealed that orgasm inadequacy was present in one third of the women in his large sample. His analysis suggests that this inadequacy may be largely genetic in origin.

J. I. COHEN.

---

# Protection of the Fauna and Flora of Africa

THE "Final Act" of the Second International Conference for the Protection of the Fauna and Flora of Africa held in London in May last has now been issued.* The Conference was held under the chairmanship of the Earl of Onslow, and was attended by delegates of the following Governments: Union of South Africa, Belgium, Great Britain and Northern Ireland, Egypt, France, Italy, Portugal and the Netherlands. The interests of the Anglo-Egyptian Sudan were represented by the United Kingdom and Egyptian delegations jointly.

The delegates met, at the invitation of the Government of the United Kingdom of Great Britain and Northern Ireland, on May 17–24, the invitation having been issued in accordance with the terms of the protocol which formed part of the agreements concluded at the International Conference for the Protection of the Fauna and Flora of Africa, held in London in 1933. The Conference had before it a number of statements which had been circulated by delegations on behalf of the Governments represented, setting out the measures which had been taken in their territories to give effect to the provisions of the Convention.

The Act sets forth the names of the delegates and advisers of each Government represented, and a list of the committee of experts appointed to make suggestions for the addition of further species to the Annex to the Convention on the occasion of its next revision. Great Britain was represented by the Right. Hon. the Earl of Onslow, Sir William F. Gowers, Mr. E. B. Bowyer and Mr. B. F. Wright as delegates, and by Mr. T. Hoskyns Abrahall, Captain Keith F. T. Caldwell, Mr. B. Cockram, Captain J. G. Dollman, Mr. J. M. Ellis, Mr. G. G. Fitzmaurice, Dr. C. Forster-Cooper, Mr. Hugh Fraser, Sir Arthur W. Hill, Mr. L. W. N. Homan, Dr. Julian S. Huxley, Dr. P. R. Lowe, Sir Guy A. K. Marshall, Sir Peter Chalmers Mitchell, Mr. A. H. Stocks, and Mr. M. J. R. Talbot as advisers. The secretary-general was Mr. Francis Hemming, and the secretary, Mr. D. H. F. Rickett. It also reports the statements made by the various delegates, who briefly outlined the measures taken by their various Governments to give effect to the provisions of the Convention.

The Act is followed by eight annexes: (1) dealing with the report of the Committee of Experts relating to the species of mammals, birds and plants recommended for inclusion in the Annex to the Convention on the occasion of its next revision (pp. 38–69), and (2) memoranda submitted by the various Governments on the action taken by them to give effect to the provisions of the Convention (pp. 70–149).

The memorandum submitted by the Belgian Government (pp. 72–73) is followed by several enclosures (pp. 74–127) in which is set forth a full and complete exposé of a decree of April 21, 1937, on "La Chasse et La Peche au Congo Belge", and a discussion of every article governing that decree and the motives which have suggested them. It is a very valuable contribution to the subject of international conservation of faunas and floras.

From the scientific, economic and biological points of view, the importance of the two African conferences which have already been held can scarcely be exaggerated, in that for the first time in history concerted international efforts have been made to ensure the preservation of the fauna and flora of an entire continent before it is too late.

* Second International Conference for the Protection of the Fauna and Flora of Africa, London, May 1938. Final Act. Pp. 149. (London: H.M. Stationery Office, 1938.) 2s. 6d. net.

For the first time in the history of the world, delegates of, and advisers to, the various Governments concerned have met together in council, armed with the knowledge and experience of the disastrous results which may follow the uncontrolled actions of blundering and profiteering man, in order to devise reciprocal measures designed to prevent such actions in the future and to conserve for all time, in so far as it is possible, the natural features and economic possibilities of a great continent.

It is true that as yet only the most elementary steps have been taken, but the important point is that a beginning has been made and definite steps in the right direction taken. Doubtless as more conferences are held, the necessity for enlarging the scope of the term 'flora' will be realized, until it comprehends the consideration of the far wider question of the preservation of the balance not only between forested and unforested areas, but also of the proper conservation of those essential areas which act like sponges for the storage of water and control the water supply of those areas of land which can be properly utilized for agricultural purposes.

In this connexion, the deliberations and actions of future conferences will surely profit by the gross mistakes which were originally made in developing the agricultural resources of such countries as the United States of America, Australia and New Zealand. In America, for example, we now know that as a consequence of ignorant and thoughtless drainage schemes, thousands of square miles of good land have literally 'gone with the wind'; while in Australia the over-zealous clearing away of forested areas has upset the biological balance of Nature, with the inevitable and consequential appearance of various plagues of an animal or vegetable nature which may, and have, cost millions of good money to combat. We would venture, therefore, to make the suggestion that the work of future conferences would be enormously benefited and its scope very profitably enlarged by the inclusion in its general body of national advisers of a sufficiency of forestry experts.

PERCY R. LOWE.

# The Morphology of the Carpel

AN important contribution to the vexed question of carpel morphology has recently been published in *La Cellule* (**47**, 287–452; 1938) by Prof. V. Grégoire, the late professor of botany at the University of Louvain (see NATURE, **143**, 400; 1939); it is characterized by the remarkable number of fine illustrations, mainly photomicrographs (no fewer than 252 in fourteen plates). The problem is approached from the point of view of development, and it is more than a coincidence that both Prof. McLean Thompson, of the University of Liverpool, and Prof. Grégoire, approaching it from this angle, reject decisively the classical theory that the carpel may be regarded as a modified leaf. The "state of flowering" of McLean Thompson and the "reproductive apex" of Grégoire necessitate a new terminology to interpret their characteristics of form, as both authors are agreed that analogies from vegetative organizations are misleading and quite unjustified.

We owe to previous papers by Prof. Grégoire and his colleagues the concept of the vegetative growth apex as establishing, in successive time intervals, or plastochrones, a series of transversely expanded foundations, which are components of the axis (the *soubassements*), upon which are then raised new foliar primordia. This mode of growth necessitates a meristem organized in depth and constructed, in modern terminology, of a tunica overlying a corpus, both of which have a meristematic nature and contribute to these successive units of shoot organization.

Prof. Grégoire points out that neither tunica nor corpus can be identified at the reproductive apex. There is a superficial meristem of uncertain depth, covering both the summit and the flanks of the apex; but this is not identified as a tunica because of the frequency with which periclinal divisions alternate with anticlinal, thus adding to the depth of parenchyma below. Below it there is no meristematic corpus at all, but a parenchymatous mass homologous with the pith. The superficial meristematic layer can add no units of construction to the shoot; the floral parts are simply emergences from it with no axial foundation such as is present with a leaf primordium. Not even the sepals are regarded now, in contradistinction to Grégoire's earlier views, as homologues of foliar structures.

The insertion of each new foliar primordium becomes the centre of a new impetus to procambial activity, the leaf-trace system of the new unit thus contributing basifugally to the vascular tracts spreading into the leaf and basipetally to the trace system linking this with the axis. In the reproductive axis, this basipetal contribution to procambial development is missing; from a procambial 'magma' often of considerable extent and sometimes spread solidly across the base of the reproductive axis, cordons of procambium, often anastomosing or bifurcating freely, spread basifugally into peduncles and then into floral parts; but there is no suggestion that this procambial activity contributes basipetally to an enlargement of the vascular system below the reproductive axis.

The two types of growth, the vegetative and reproductive, are fundamentally distinct and not reducible to a common plan. A reproductive apex does not even develop out of a vegetative apex by its gradual modification; it arises as a lateral growth on the side of the vegetative apex that it displaces, and if subsequent proliferation shows a return to foliar emergences then a vegetative apex has re-arisen adventively on a reproductive axis. Such a reproductive axis, always a layer of meristem tissue upon a parenchymatous plinth, still capable of some growth and extension (the *porte-méristème* of Grégoire) may be used up entirely in the production of floral parts, it may dichotomize by the development of a central groove, or divide into more fragments as the result of more grooves developing. Its floral members arise without plastochronic intervals and these members are local products of a portion of the meristem without the tendency to bilateral spread around the axis characteristic of the foliar primordium.

Grégoire distinguishes two types of carpels among those now described: the *Ranunculus* type, in which a

transverse or tangential slit separates a dorsal upcurving and enclosing segment from a ventral, on the abaxial face of which a single ovule arises in the median position; and the *Aquilegia-Rubus* type, in which a very narrow radial slit is present between two lateral walls, joined external by a strongly developed dorsal wall which runs up into the stigma. This type gives the follicle which is the basis of the foliar theory of the carpel, but Grégoire points out that the thin radial slit first formed does not agree at all with the concept of two incurving leaf margins joining to give the ventral suture. In the *Aquilegia-Rubus* type this thin slit later expands at its outer margin to give the cavity on which are formed the ovules, few in number but necessarily lateral in position, but in *Papaver*, *Butomus*, etc., the whole surface of the slit is meristematic and active in the production of ovules. Prof. Grégoire shows that perigyny is a natural development of the outer margin of the parenchymatous plinth upon which the reproductive meristem is carried; he thus excludes its interpretation as a concrescence of sepals. He emphasizes that from the new point of view perigynous forms are not to be interpreted as intermediate between epigynous and hypogynous.

The whole paper is a vigorous challenge to classical morphology in a field where there has been much activity in recent years. Prof. Grégoire refused to consider the palæobotanical contributions to this problem and the cupule theory that has thus emerged; but apart from this there is a very full discussion of the bearing of his most recent observations upon the diverse interpretations that have been given to the carpel.

## The S.S. *Archimedes*

IN March 1839, the historic little screw-driven vessel S.S. *Archimedes* began her trials in the River Thames. A month or two later she visited Portsmouth, and afterwards made voyages around the coasts of Great Britain and to Holland and Portugal. She was the first vessel to demonstrate effectively the suitability of the screw for ocean-going ships and she ushered in the revolution which led to the abandonment of paddle-wheel propulsion in the ships of both the Royal Navy and the Mercantile Marine.

The *Archimedes* was built of wood at Millwall by Henry Wimshurst (1804–84) for the Ship Propeller Company, a syndicate formed to further the use of the screw-propeller patented by Francis Pettit Smith on May 31, 1836. Smith had previously built a small screw-driven boat of 6 tons bearing his name. The *Archimedes* was 125 ft. long overall, 106 ft. long between perpendiculars, 22½ ft. beam and drew between 9 ft. and 10 ft. of water. Her tonnage was 240 tons. Her machinery consisted of a two-cylinder steam-engine driving the propeller shaft through spur gearing. The cylinders were 37 in. in diameter and 3 ft. stroke. With steam at 6 lb. pressure the engine developed about 80 horse-power. The engine speed was 26 revolutions per minute and the propeller speed 140 revolutions per minute. The first screw fitted was of 7 ft. diameter, 8 ft. pitch and 8 ft. long. This in 1840 was replaced by a double-bladed screw of 5½ ft. diameter, 10 ft. pitch but of greatly reduced length, but various other screw propellers were also tried. Her machinery was made at Greenwich by J. and G. Rennie. The total cost of the vessel was £10,500.

In accordance with Admiralty instructions early in 1840, Captain E. Chappell, who had been associated with the Steam Facket Service, took command of her and a series of trials were carried out at Dover between the steam packet *Widgeon* and the *Archimedes*. The *Widgeon* was 162 tons and was the fastest boat on the Dover station. The trials were attended by Thomas Lloyd, who afterwards became the first Engineer-in-Chief of the Navy. The joint report of Chappell and Lloyd dated May 2, 1840, was the first official report made to the Admiralty on screw-propulsion. In it it was stated that "it is evident in these vessels the power of the screw is equal, if not superior to that of the ordinary paddle-wheel. In this respect therefore Mr. Smith's invention may be considered completely successful." After some remarks on the noise and wear of the gearing, the teeth of which were of wood, the report went on to say that "It is, however, in propelling vessels of war that the value of Mr. Smith's invention will probably be experienced. . . . A ship fitted with a screw propeller may be used either as a sailing or a steaming vessel, or as both, if required; for we ascertained by experiment that the engine can be connected and disconnected with ease, and in any weather, in two or three minutes. In carrying a press of sail, the inclination of the ship does not diminish the propelling power of the screw nor lessen the ship's way, as with the ordinary paddle-wheel. The getting rid of the paddle-boxes also leaves the broad-side battery altogether clear of obstruction, and in boarding an enemy's vessel would allow of the ships lying close alongside of each other".

Experiments with the *Archimedes* were also carried out at Bristol by Brunel, and it was through these that he was led to adopt screw-propulsion for the famous *Great Britain*, the first screw-driven ship to cross the Atlantic.

## University Events

CAMBRIDGE.—The Jacksonian professorship of natural philosophy is vacant. The stipend of the professor is £1,200 a year or, while he holds a fellowship of a college with dividend, £1,000. The professorship is assigned for this turn to experimental atomic physics and will be associated with the Cavendish Laboratory. Candidates are requested to send their names to the Vice-Chancellor on or before April 11, 1939, with twelve copies of any statement or testimonial which they desire to submit to the electors.

The Smith's Prizes have been awarded to T. E. Easterfield, of Clare College and H. N. V. Temperley, of King's College; and Rayleigh Prizes to J. Corner, of Peterhouse, D. S. Evans, of King's College, R. A. Rankin, of Clare College and D. B. Schultz, of Magdalene College.

ST. ANDREWS.—Prof. E. Finlay Freundlich, formerly professor in the German University, Prague, has been appointed Napier lecturer in astronomy and director of the new Astronomical Observatory in the United College, St. Andrews. The lectureship owes its institution to a bequest made to the University by the late Miss Scott Lang, daughter of Sir Peter Scott Lang, formerly professor of mathematics in the United College. It was the desire of Sir Peter Scott Lang that the lectureship should bear the name of Napier of Merchiston, one of the early students of the University.

# Societies and Academies

## London

Royal Society (*Proc.*, A, **169**, 451–590; 1939)

W. H. J. CHILDS and H. A. JAHN: A new Coriolis perturbation in the methane spectrum. (3) Intensities and optical spectrum.

W. H. B. CAMERON and A. ELLIOTT: Emission band spectrum of chlorine. (3) Continua.

A. ELLIOTT: A band spectrum attributed to NBr.

G. TEMPLE: General theory of relaxation methods applied to linear systems.

W. C. PRICE and D. M. SIMPSON: Absorption spectra of carbon dioxide and carbon oxysulphide in the vacuum ultra-violet.

T. S. CHANG: Statistical theory of the adsorption of double molecules.

E. J. WILLIAMS: Concerning the scattering of fast electrons and of cosmic-ray particles.

W. HIRST and G. E. HARRISON: Diffusion of radon gas mixtures.

## Paris

Academy of Sciences (*C.R.*, **208**, 473–544, Feb. 13, 1939).

A. GOSSET, A. TCHAKIRIAN and J. MAGROU: Chemical composition of the bacterial tumours of *Pelargonium zonale* and of the tissues at the expense of which they develop. Content of potassium and phosphorus is higher, and that of silica, calcium and magnesium is lower, in these tumours than in stem tissue. Similar differences are said to occur in animal neoplasms.

H. VINCENT: Hepato-renal 'dysphylaxy' in relation to coli bacillary infection.

P. LEJAY: Isostasy and positive anomalies of gravity in certain mountainous massifs and in particular in the Zambalès chain (Luzon, Philippines).

J. HAAG: Deformation of an elastic thread under the action of gravity.

F. CHÂTELET: Classification of curves of order one, in the *corps des restes*, modulus $p$.

C. PAUC: Continua which are limits of definition of a continued function passing through each value a finite number of times.

J. TOUCHARD: Sines of the third order.

J. KUNTZMANN: Multiform systems and hypercomplex systems.

J. VIGNAL: Formulæ for the evaluation of the precision of a method of levelling.

J. GÉHÉNIAU: Remarks on the densities of matrices and the non-Maxwellian magnitudes in the theory of the photon.

MLLE. M. MAUCHERAT: Vapour pressure of lithium between 462° and 642°. Extrapolation gives the boiling point under atmospheric pressure as 1,530° K.; the heat of vaporization is 36,600 cal./gm. atom.

J. TONNELAT: An automatic apparatus for correction for the displacement of the zero of a galvanometer.

W. UYTERHOEVEN and C. VERBURG. Temperature of electrons ($T_e$) in a positive column discharge with alternating current (50 cycles); measurements in a neon-sodium mixture (sodium vapour lamp).

A. FORTIER: Viscosity of air and the electronic charge. Values obtained are $u_{23} = (1834{\cdot}1 \pm 1{\cdot}9) \times 10^{-7}$ C.G.S. units and $e = (4{\cdot}813 \pm 0{\cdot}010) \times 10^{-10}$ E.S.U.

J.-J. TRILLAT: A process for recording electron diffraction diagrams. Fine-grain photographic plates are solarized, and once developed and fixed, remain transparent uniquely at the places struck by electrons, thus avoiding the usual blurring caused to secondary X-rays. It is not necessary to handle the plates in darkness.

H. MURAOUR, A. MICHEL-LÉVY and J. ROUVILLOIS: Study of explosion luminosities.

G. DÉJARDIN: Luminous discharge in nitrogen in the presence of sodium chloride.

S. NIKITINE: Theoretical considerations on the sign of photodichroism.

R. DELAPLACE: Specific heat and density of castor oil and of a mineral oil, of aviation type, at different temperatures.

C. HOLTERMANN and P. LAFFITTE: Formation and dissociation of strontium peroxide.

P. CASTEL: Trithoric orthophosphate.

J.-M. DUNOYER: Reduction and decomposition of chromic anhydride.

Y. DEUX: Pinacolic transposition in the course of duplicate reduction of mesityl oxide; migration of methyl.

MLLE. J. GUTMAN: Action of dimethylamine on methyl-1-dibromo-3-4-cyclohexane.

A. TCHITCHIBABINE and C. HOFFMANN: Contribution to knowledge of 6-methoxy-8-aminoquinoline and its derivatives.

O. K. HOUO: Preparation of β-ethylenic alcohols, branched at α.

F. BOURDIER: The Wurm, Riss and Mindel moraines in Bas-Dauphiné, their distinctive characters and their probable correlation with certain depots of human industries.

G. VIEL: Celluloses of some Algæ.

R. SOUÈGES: Embryogeny of the Begoniaceæ; development of the embryo in *Begonia semperflorens* Link and Otto.

MME. C. SOSA-BOURDOUIL: Correlations between the protein nitrogen content of some pollens and the classification of the Ranunculaceæ.

J. VELLARD: Variations *in vitro* of globular resistance under the influence of snake venoms.

J. REBOUL: Action of X-rays on biological elements; the factor of recuperation.

M. VIOLLE and L. PLACIDI: A particular modality of phenomena of shock.

## Amsterdam

Royal Netherlands Academy (*Proc.*, **42**, No. 1, 1939).

J. G. VAN DER CORPUT: Contribution to the additive theory of numbers (5).

A. H. BLAAUW, IDA LUYTEN and ANNIE M. HARTSEMA: Early flowering of Dutch irises (2). A further study of the effect of storage at various temperatures on the early flowering of the Dutch iris Imperator.

H. A. BROUWER: Leucite rocks of the active volcano Batoc Tara (Malay Archipelago).

C. U. ARIËNS KAPPERS and K. H. BOUMAN: Comparison of the endocranial casts of the *Pithecanthropus erectus* skull found by Dubois and von Koenigswald's *Pithecanthropus* skull. Further evidence of the close similarity of the two skulls.

C. U. ARIËNS KAPPERS: Index curves of Asia and the Great Sunda Islands.

E. M. BRUINS : Decay of the penetrating cosmic rays. The penetrating component is believed to consist of heavy electrons. According to Euler and Heisenberg, the latter decay to form electrons in a lifetime which can be estimated from absorption measurements. Calculations are here given of the modification of the energy spectrum of the heavy electrons as they pass through the atmosphere.

K. MAHLER : On the solutions of algebraic differential equations.

J. TEGHEM : Uniform distribution, mod. 1.

A. J. RUTGENS and E. VERLANDE : Flow potentials and surface conductivity (2). A calculation of the variation of the electrostatic potential in a fluid in the neighbourhood of a highly charged wall.

F. A. VAN BAREN : Petrography and mineralogy of some rocks and sand samples from the Gajo Loceus, Atchin (Dutch East Indies).

H. G. BUNGENBERG DE JONG and O. BANK : Behaviour of microscopic bodies consisting of biocolloid systems suspended in an aqueous medium. (3). Coacervation phenomena in droplets of biocolloid sols enclosed in a collodion film. Accumulation of basic dyes.

## Budapest

Royal Hungarian Academy of Sciences, February 20.

J. MAREK : Bone disease as a consequence of irregularities in mineral metabolism.

E. NEUBER : Preservation of the health of youth.

G. RADOS : Cyclic unitary substitution.

K. SCHAFFER : Relation of the Tay-Sachs disease to metabolism.

G. ZEMPLÉN : Synthesis of rubierythric acid.

I. VITALIS : Coal production in Hungary.

GY. SZÓKEFALVI-NAGY : Genus-number of one-sheeted surfaces of maximal index.

J. STILLER : Peritricha fauna of Heligoland.

A. ÁBRAHÁM : Microscopic innervation of the alimentary canal of snails.

L. JUGOVICS : Andesitha from the Cserhát Mountains containing traces of asphalt (petroleum).

S. SZALAY : Observations upon the $^{31}_{15}P$ and $^{14}_{7}N$ nucleus in their excited states.

Z. KASZAB : Zoological results of Miklós Vasvári's expedition to Asia Minor. (1) Tenebrionidæ.

## Rome

National Academy of the Lincei (*Atti*, **27**, 609–716 ; 1938).

G. ARMELLINI : Fundamental problems of cosmogony and Newton's law (2).

U. BARBIERI : (1) Large geoidic anomaly in the Valle Padana. (2) Extension of the geoidic anomaly in Val Padana, and the zero iso-anomalous line for gravity.

R. BADESCU : Simplifications and extensions of Picone's method of integrating linear equations to partial differential equations of the second order of hyperbolic type.

A. DE MIRA FERNANDES : Structure equations of the groups of Lie.

M. HAIMOVICI : Totally geodetic surfaces in Finsler's spaces.

J. C. VIGNAUX : Polygenic functions of a dual bicomplex variable (2).

F. VYČICHLO : Contributions to the projective geometry of anholonomous varieties. (1) Topological theorem for the $V_n^m$ varieties of the element $S_n$. (2) $V_3^2$ in $S_3$ : Darboux's quadrics, Lie's quadric, and Green's angles.

F. LEVI : States of coaction in an elastic system for exceeding the limit of elasticity.

E. PISTOLESI : Non-permanent motion of a solid in an incompressible indefinite fluid.

M. CIMINO : Definite orbit of Finlay's comet.

G. WATAGHIN : Quantum theory and the origin of some showers of cosmic rays.

V. ZAGAMI : Experimental researches on the seminal fluid. Osmotic pressure, electrical conductivity, and hydrogen ion concentration of the human seminal fluid (5). Osmotic pressure, electrical conductivity, and hydrogen ion concentration of the dog's seminal fluid (6).

S. DOJMI DI DELUPIS : Phenomena of activation in vegetable growth, (2) and (3).

G. GABRIELI : Re-discovered relics of Lincean scientific publications.

*Atti*, **28**, 3–74 ; 1938.

M. VILLA : Characteristic differential property of cones projecting the varieties which represent the totality of quadrics of a linear space.

C. TOLOTTI : Equilibrium of solids and related transformations.

L. GIALANELLA : Motion of an electrically charged particle in presence of a magnetic dipole (1).

E. VOLTERRA : Researches on elastic arches : Resolution by the methods of 'coupled elasticity' of a special type of arch.

A. FRANCAVIGLIA : Contribution to the knowledge of the geological constitution of the edge of the Ethiopian plateau.

M. MITOLO : Possible synthesis of the antiscorbutic vitamin in guinea pigs.

E. FULCHIGNONI : Behaviour of the heart in epilepsy from cortical faradization.

A. CURATOLO : A method for the volumetric determination of small quantities of silver in tissues and fluids of an organism.

A. SALVATORI : Effect of endomuscular injections of aqueous extracts of liver, kidney and intestine on the chlorœmic content in the white rat.

G. CASTELNUOVO : Further researches on the influence of sex hormones on the maturation of carp.

E. MARIOTTI : Chemical composition of the muscular proteins of the trout in relation to sexual maturation.

D. FALLERONI : Differentiation of races of *Anopheles maculipennis* and its importance for the solution of the malaria problem.

*Atti*, **28**, 75–116 ; 1938.

G. A. BLANC and T. MANTOVANI : Geochemical interpretation of the quaternary formations of Grotta Romanelli (Terra d'Otranto) (2). Colloidal complexes.

L. AMERIO : A typical example in the theory of the Laplace transformation.

C. AGOSTINELLI : First integrals of the equations of motion of an electrically charged corpuscle, in presence of $n$ magnetic poles with superimposed axes.

G. BISCONCINI : A particular case of incipient motion, especially applicable to the gyroscope.

L. MONTI : Oxidizing action of selenium dioxide (3).

M. FENOGLIO : Two minettes from Val Nambrone (Adamello Group).

A. C. BLANC : New palæolithic and mesolithic deposits in the Balzi Rossi of Grimaldi.

E. TOSATTI : Respiratory function of straight and crossed fibres in the anterior of the tract cervical chord.

## Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

### Tuesday, March 21

ROYAL COLLEGE OF PHYSICIANS, at 5.—Prof. J. A. Gunn: "The Pharmacological Actions and Therapeutic Uses of some Compounds related to Adrenaline" (Oliver-Sharpey Lectures. Succeeding lecture on March 23).

### Friday, March 24

GEOPHYSICAL DISCUSSION (at the Royal Astronomical Society) at 4.30.—"Recent Geophysical Investigations at Sea" (to be opened by Dr. E. C. Bullard).

PHYSICAL SOCIETY (at the Imperial College of Science and Technology), at 5.15.—Brigadier M. N. MacLeod: "Some Recent Developments in British Surveying Instruments" (Thomas Young Oration).*

---

INSTITUTE OF PHYSICS, March 23–25.—Conference on "Physics in the Textile Industries" to be held in the University of Leeds.

---

## Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT (grade II) in the Balloon Development Establishment, Cardington—The Under-Secretary of State, Air Ministry (S.2.D), Berkeley Square House, W.1 (March 24).

JACKSONIAN PROFESSOR OF NATURAL PHILOSOPHY in the University of Cambridge—The Vice-Chancellor (April 11).

LECTURER IN PHYSICS in the Battersea Polytechnic, London, S.W.11—The Principal (April 21).

---

## Reports and other Publications

*(not included in the monthly Books Supplement)*

### Great Britain and Ireland

Association of Technical Institutions: Association of Principals of Technical Institutions. Report of the Joint Committee on the Application of Psychological Tests in Technical Institutions. Pp. 20. Libraries in Technical Institutions. Report by a Joint Committee. Pp. 64. (Loughborough: Loughborough College.) [162

Carnegie Trust for the Universities of Scotland. Thirty-seventh Annual Report (for the Year 1937–38) submitted by the Executive Committee to the Trustees on 15th February 1939. Pp. iv+208. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [172

The Journal of the Institute of Metals. Vol. 63 (No. 2, 1938.) Edited by S. C. Guillan. Pp. 314+29 plates. (London: Institute of Metals.) 31*s.* 6*d.* net. [172

University of Oxford: Bureau of Animal Population. Annual Report, 1937–38. Pp. 36. (Oxford: University of Oxford.) [202

Empire Cotton Growing Corporation. The Work of the Experiment Stations, Season 1937–38; an Explanatory Review. By W. Nowell and Dr. J. W. Munro. Pp. 30. (London: Empire Cotton Growing Corporation.) 1*s.* 6*d.* [212

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge during the Academical Year 1937–1938. Pp. 152. (Cambridge: At the University Press.) [212

### Other Countries

Smithsonian Institution: U.S. National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1938. Pp. iii+121. (Washington, D.C.: Government Printing Office.) 20 cents. [162

U.S. Department of the Interior: Office of Education. Leaflet No. 31: Government Publications of use to Teachers of Geography and Science. Pp. 16. (Washington, D.C.: Government Printing Office.) 10 cents. [162

U.S. Department of Agriculture. Circular No. 504: Early Winter Food of Ruffed Grouse on the George Washington National Forest. By A. L. Melson, Talbott E. Clarke and W. W. Bailey. Pp. 38. 5 cents. Technical Bulletin No. 642: The Field Cricket in relation to the Cotton Plant in Louisiana. By J. W. Folsom and P. A. Woke. Pp. 28. (Washington, D.C.: Government Printing Office.) [162

Smithsonian Miscellaneous Collections. Vol. 98, No. 1: Two Remarkable New Species of Marine Shells from Florida. By Paul Bartsch. (Publication 3524.) Pp. 4+1 plate. (Washington, D.C.: Government Printing Office.) [162

Transactions of the New York Academy of Sciences. Ser. 2, Vol. 1, No. 3: The Late Physical History of the Rocky Mountains in the United States. By Dr. Wallace W. Atwood. Pp. 29–52. (New York: New York Academy of Sciences.) [162

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 90. Zoological Results of the Second Dolan Expedition to Western China and Eastern Tibet, 1934–1936. Part 1: Introduction. By Brooke Dolan, II. Pp. 159–184+plates 12–20. Zoological Results of the Second Dolan Expedition to Western China and Eastern Tibet, 1934–1936. Part 2: Birds. By Ernst Schäfer and Rodolphe Meyer de Schauensee. Pp. 185–260 Zoological Results of the Second Dolan Expedition to Western China and Eastern Tibet, 1934–1936 Part 3: Mammals. By Glover M. Allen. Pp. 261–294+plates 21–24. A New Rodent of the Genus Rheomys from Chiriquí. By Robert K. Enders. Pp. 295–296. (Philadelphia, Pa.: Academy of Natural Sciences.) [16

Transactions of the Academy of St. Louis. Vol. 29, No. 4: Geological Aspects of Evolution. By Victor T. Allen. Pp. 89–106. (St. Louis, Mo.: Washington University.) [17

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 40, Part 3: Structure and Function of the Female Genital System of *Bombyx mori* with Special Reference to the Mechanism of Fertilisation; Studies on the Reproductive System of the Male of *Bombyx mori*, 2: Post-Testicular Organs and Post-Testicular Behaviour of the Spermatozoa. By Seinosuke Omura. Pp. 111–170+6 plates. (Tokyo: Maruzen Co., Ltd.) [17

Annual Report of the Director of the Japan Institute for Science of Labour for 1937. By Dr. G. Teruoka. Pp. 37. (Tokyo: Japan Institute for Science of Labour.) 70 sen. [202

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, No. 103: Studies of Irregular Variable Stars. By Frida Palmér. Pp. 168. Ser. 1, No. 136: On the Influence of the Major Planets on the Meteorite Tracks and a Criticism of the Meteorite Hypothesis of the Sunspot Periodicity. By Conrad Lönnquist. Pp. 12. (Lund: Astronomiska Observatorium.) [202

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 46: Technological Reports on Trade Varieties of Indian Cottons, 1938. By Dr. Nazir Ahmad. Pp. v+150. (Bombay: Indian Central Cotton Committee.) 1.8 rupees. [202

Bergens Museum. Årsberetning, 1937–38. Pp. 114. (Bergen: A/S John Griegs Boktrykkeri.) [202

Field Museum of Natural History. Geological Series, Vol. 7, No. 4: Additional Notes on the Grinnell Ice-Cap. By Sharat K. Roy. Pp. 59–70. 20 cents. Zoological Series, Vol. 20, No. 35: A New Woodrat from Mexico. By Wilfred H. Osgood. Pp. 475–476. 10 cents. Zoological Series, Vol. 20, No. 36: A New Pigeon from Colombia. By H. B. Conover. Pp. 477–478. 10 cents. Zoological Series, Vol. 20, No. 37: A New Wood Owl from Chile. By Leslie Wheeler. Pp. 479–482. 10 cents. (Chicago: Field Museum of Natural History.) [202

Indian Forest Records (New Series). Utilization, Vol. 1, No. 7: Official List of Trade Names of Indian Timbers. Revised third edition. Pp. iii+189–210. (Delhi: Manager of Publications.) 8 annas; 9*d.* [202

Journal of the Indian Institute of Science. Vol. 21A, Part 18: Electrometric Titration of Tannic Acids. Part 1: Electrometric Titration of Ellagic, Ellagitannic and Chebulinic Acids. By S. R. Sunthankar and S. K. K. Jatkar. Pp. 189–208. 1.8 rupees. Vol. 21A, Part 19: Electrometric Titration of Tannic Acids. Part 2: Electrometric Titration of Gallic and Gallotannic Acids. By S. R. Sunthankar and S. K. K. Jatkar. Pp. 209–222. 1.2 rupees. Vol. 21A, Part 20: Equilibrium in Electrodeless Discharge. Part 5: Equilibrium in the Dissociation of Oxygen and in the Formation of Ozone in Silent Electric Discharge. By R. Krishnan and S. K. K. Jatkar. Pp. 223–236. 1.2 rupees. Vol. 21A, Part 21: Adsorption of Gelatin by Precipitated Hydroxides. By J. G. Kane. Pp. 237–244. 12 annas. Vol. 21A, Part 22: Supersonic Velocity in Gases and Vapours. Part 1: Aberrations of Supersonic Interferometers in Gases. By S. K. Kulkarni Jatkar. Pp. 245–272. 2 rupees. Vol. 21A, Part 23: Reactions of Chromates at High Temperatures. Part 7: Decomposition of Barium Chromate, and of Mixtures of Barium Chromate with Barium Carbonate. By V. T. Athavale and S. K. K. Jatkar. Pp. 273–284. 1 rupee. (Bangalore: Indian Institute of Science.) [202

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 123: A Soil Survey of the Merbein Irrigation District, Victoria. By F. Penman, J. K. Taylor, P. D. Hooper and T. J. Marshall. Pp. 44. Bulletin No. 124: The Wood Anatomy of some Australian Meliaceæ with Methods for their Identification. By H. E. Dadswell and Dorothie J. Ellis. (Division of Forest Products, Technical Paper No. 31.) Pp. 20+6 plates. (Melbourne: Government Printer.) [202

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. Petroleum Fuels in Canada: Deliveries for Consumption, Calendar Year 1937. Prepared by John M. Casey. (No. 794.) Pp. ii+20. (Ottawa: King's Printer.) 10 cents. [202

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 18: Milk Records of Cattle in Approved Dairy Farms in India. Compiled by K. P. R. Kartha. Pp. vi+175. (Delhi: Manager of Publications.) 2.12 rupees; 4*s.* 6*d.* [202

Union Géodésique et Géophysique Internationale. Sixième Assemblée générale, Edimbourg, Septembre 1936. Procès-verbaux des séances de l'Association de Météorologie. 2: Mémoires et discussions. Pp. 331. (Paris: Union Géodésique et Géophysique Internationale.) [202

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Mémoire No. 85: Faune malacologique des Sables de Wemmel. 2: Gastropodes, Scaphopodes, Céphalopoda. Par Maxime Glibert. Pp. 192+4 plates. Deuxième Série, Fasc. 14: Oligocene Arcid Pelecypods of the Genus Anadara. By Hubert G. Schenck and Philip W. Reinhart. Pp. 74+6 plates. Hors Série. Résultats scientifiques du voyage aux Indes Orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Vol. 3, Fasc. 19: Arancæ. Von C. Fr. Roewer. Pp. 94. (Bruxelles: Musée Royal d'Histoire Naturelle.) [202

Tanganyika Territory: Department of Lands and Mines, Geological Division. Bulletin No. 11: Explanation of the Geology of Degree Sheet No. 29 (Singida). By N. W. Eades and W. H. Reeve. Pp. 62+8 plates. (Dar es Salaam: Government Printer.) 4*s.* [212